THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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	Page
Suction Gas Power	245
The Patents and Designs Bill	246
Electrical Trade with Australia	247
The Constitution of Matter	247
Kotyra Keyboard Wheatstone Perforator (*illus.*)	248
Records and Drawings of Electric Mains (*illus.*)	249
Correspondence:—	
Regenerative Control	251
I.M.E.A. Convention	251
Electricity Supply Accounts	252
Inductor Alternator Design (*illus.*)	253
The British Association Meeting at Leicester:—	
The Density of the Ether	253
The New Engineering Laboratory at the City and Guilds of London Institute, Finsbury	253
The Ice Problem in Engineering Work in Canada	254
Electrical Standards	254
Legal	257
Parliamentary	257
Business Notes	258
The Electrification of the Hammersmith and City Section of the Great Western Railway (*illus.*) (*concluded*)	263
Notes	271
City Notes	272
Electric Tramway and Railway Traffic Returns	274
Stocks and Shares	274
Share List of Electrical Companies	275
Experiments with Concrete Telegraph Poles	277
The East Indian Telegraph Service	278
Review of the L.G.B. Departmental Committee's Report relating to Electricity Supply Undertakings	278
Reviews	279
The Demands of Labour	281
The Future of the Electrical Industry	282
New Patents Applied For, 1907	284
Published Specifications	284

THE

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SUCTION GAS POWER.

IT is only natural that the suction-gas plant should, by reason of its novelty, be a somewhat unknown factor, and should, therefore, be the subject of discussion rather out of proportion to its intrinsic merit. It has been seriously suggested that it is an appreciable competitor to centralised power supply, the advocates of the new power looking, of course, at the question through rose-coloured spectacles, and those interested in the older power investing the problem with what may be termed a tinge of blue. As a matter of fact, the position seems to be that the suction-gas producer is of undoubted value in situations where power is required, and where no supply from a centralised source is available. A similarity exists between this problem and that of whether to use oil lamps, gas lamps or electric lamps for illumination.

Unfortunately, in the discussion which has arisen on the subject, many misstatements have been made, both for and against suction gas, which will require years of experience effectually to subdue. A writer in a recent issue of *Gas and Oil Power* draws attention to one or two of these. He refers, first, to the prevalence of an idea that gas engines are unsuitable for driving factory plant where the individual machines perform a heavy duty. One instance which he cites in correction of this is a plant consisting of a large horizontal reciprocating saw with travelling table, taking oak logs in tree form up to about 42 in. diameter, and a circular saw on a "push bench" with saws up to 48 in. diameter. These are driven by a 40 maximum B.H.P. suction gas plant, which, it is stated, readily responds to the variations of load.

Another case mentioned is that of a 60-B.H.P. plant running 17 sets of heavy rolls for cardboard sheets. The load continually varies from a very slight minimum to about 80 B.H.P., never remaining steady for more than a few seconds.

These are creditable performances, and remove a feeling of distrust in variable load capabilities which the vagaries of earlier suction-gas plants undoubtedly produced. It is, however, only fair to consider the question from all standpoints. The question of economy is most certainly akin to that of breakdown, since both affect the efficiency of a works plant. It should be remembered that, while the gas plant may get through a variable load, it does so only at a price. Everyone knows the extreme inefficiency of a gas engine at light loads, even when fed with gas of uniform quality. This is likely to be intensified when the varying requirements of the load draw over from the producer gas of qualities

which vary from moment to moment. When contrasted with the performance of an electric motor which at quarter-load does not go below 75 per cent. efficiency, while at full-load and overload it is away up in the nineties, it is seen that the cough-and-kick performance of the gas engine leaves very much to be desired from the money standpoint.

The next point made by the writer is that it is not, as is generally supposed, necessary for a suction plant and engine to be in as close proximity as is desirable for a steam engine and boiler; and he cites a case where the suction plant and engine are separated by about 110 ft., and another where the distance is nearly 150 ft.

From the similarity of Mond gas and suction gas we are somewhat surprised that the notion of distance limits should have got abroad, unless actual trouble has been experienced with long transmissions. The root of the trouble has probably been that, in order to cut down the cost of transmission piping, the bore was not made large enough to carry the requisite gas without putting an undue strain on the "sucking power" of the engine. It is purely a question of design. But the awkward part of any design is the cost thereof; for long distances a pipe-line of adequate dimensions is a trifle costly, and it is here that the comparison between suction gas and electricity shows up badly for the former. It will in most cases be found (*i.e.*, when ordinary situations for cable runs out of reach of extreme damp, heat, or other disturbing factors are considered) that the cost of an electric cable run to a motor is less than that of a pipe-line run to a gas engine.

The third fallacy exploded is that one suction-gas producer cannot feed two engines. The case used as illustration is that of a London factory in which an engine of 70 maximum B.H.P. is run from a gas plant comparatively close to it, while an engine of 13 B.H.P. fed by a pipe-line 120 ft. long takes its gas from the same plant. If this feature is found generally correct, it will remove in some cases a point of previous peril for suction-gas plants—variability of load. By putting two or more engines on to one plant a diversity factor will be introduced which will be of value in keeping the producer steadily at work. That, however, there is a certain amount of difficulty in thus "compounding" gas engines into one plant seems to be indicated by the remark, "A little practical experience in dealing with the special provisions met with in each particular case is all that is needed to ensure success." In view of the unfailing success of electric motors running in parallel, it would be of very great interest to have from the writer of the article mentioned, who has evidently had considerable practical handling of suction-gas plant, a more detailed account of the difficulties he has from time to time met with in the installation of such plants, and the various ways in which they have been overcome.

Of course, the object of the article is to show that suction-gas plants are not so black as they are painted, and presumably to encourage possible, but doubtful, users of suction gas to take their courage in both hands and try it.

It does not profess, however, to be a complete statement of claims, as it only deals with two or three points upon which the public look on the suction-gas plant with disfavour. There are others, however, which have exposed the apparatus to considerable suspicion by possible buyers. An example is that of safety, and that such suspicion appears to be well founded can be evidenced by the following extracts, both taken from one recent issue of the *Journal of Gas Lighting*:—

> When a gas-producer engine was being started at a woollen cloth factory at Trowbridge one day last week, an explosion occurred, severely injuring two men. Both, it is stated, had a narrow escape of their lives, as missiles were hurled in all directions.
>
> Last week, whilst engaged in starting the suction-gas plant at the Central Wales Granite Works, at Llandrindod Wells, six men were overcome by an escape of gas, and were found in a precarious condition. Three of them were removed to the Cottage Hospital, but later reports stated that all were progressing favourably.

The Patents and Designs Bill.

On the consideration by the House of Commons of this Bill as amended in Standing Committee, some important amendments were made. The cost and difficulty of the present procedure before the Privy Council for obtaining an extension of the fourteen years, which is the maximum period for which a patent is granted, has been a real grievance to inventors whose inventions are of such a nature that they cannot be developed and made profitable within that period. The patent for such an invention as the steam turbine, for example, might expire before the inventor could possibly make sufficient profit to reward him for the labour and capital expended in its development. A clause has now been added to the new Bill, which will make it possible to obtain an extension of as much as fourteen years by application to the special Court for the consideration of patent cases. The Court may also order the grant of a new patent for such term as may be specified in the order, and containing any restriction, conditions and provisions the Court may think fit.

Another clause was added to the Bill, making it necessary to stamp a patented article with the year and number of the patent. Unless this is done, the patentee will not be entitled to recover any damages in an action for infringement. This appears to us to be a useful provision, as it will tend to prevent the fraudulent marking of articles as patented when the patent is void.

Mr. Lloyd-George was prepared to reduce the time within which application could be made for the revocation of a patent from four years to two, and to allow an appeal from the Court of first instance to the Court of Appeal and the House of Lords. This is a desirable amendment, since it appears to be rather hard on a patentee to keep the fear of revocation hanging over his head for so long a period as four years.

Some opposition was offered to Clause 15, which provides for the revocation of patents worked outside the United Kingdom. It was pointed out by Lord R. Cecil that this was a crude form of protection, but it was defended by Mr. Lloyd-George on the assumption that many foreign patentees manufactured their inventions abroad even when they could manufacture them more cheaply in this country, thus sacrificing profits to Anglophobia. If such persons exist, the clause may be of some use. It will doubtless have the effect of causing many foreign firms to establish factories in this country when otherwise they would not have done so. In some cases this will increase the cost of manufacture, in others no doubt the manufacturers will discover that they can manufacture quite as cheaply here as abroad, but they will probably bring foreign workmen with them, in which case the advantage to our artisans is not obvious.

Clause 23, which relates to the avoidance of certain conditions attached to the sale, &c., of patented articles, was severely criticised, but was finally accepted. It is bad

policy, as a rule, to interfere with freedom of contract, but this appears to be a case where interference is necessary. Whether or not the lawyers will discover some method of getting round the clause remains to be seen.

Electrical Trade with Australia.

British electrical engineering firms will not find much to interest them in the Blue Book which was issued on Saturday in relation to the conditions and prospects of trade in Australia, by the Advisory Committee on Commercial Intelligence of the Board of Trade. The document, which is a report based upon materials collected by Mr. R. J. Jeffray, who went to Australia in June, 1905, as a Commissioner on behalf of the Committee, largely concerns the textile and iron and steel trades, but the information respecting electrical questions is exceedingly meagre. The first reference is contained under the heading of builders' hardware, where electrical supplies are mentioned, and the trade in these is stated to appear to be chiefly in the hands of American and Continental manufacturers. As far as mining plant is concerned, the greater portion of the requirements of the State of Victoria are met by local manufacturers. These include steam engines of various kinds, "electric engines," oil engines, electric pumping plant, steam winches, &c. The statements furnished by various Inspectors in the State cover goods of the value of £1,246,000, and no less than 89 per cent. were made in Victoria, the balance being for the most part from the United Kingdom. In the case of New South Wales, the predominance of the local manufacturers is not so manifest as in Victoria. The principal articles introduced at Broken Hill alone in 1904 and 1905 comprised machinery and rails from the United Kingdom of the value of £171,000, explosives and electrical and other machinery and appliances from Germany amounting to £45,000, and electrical appliances from Switzerland reaching the value of £8,300. The report gives detailed tables showing for the Australian Commonwealth, as a whole, the value of each principal article imported from countries outside the Commonwealth in each of the years 1880, 1890, 1900, 1903, 1904 and 1905, distinguishing the sources of supply in so far as the information is available. We extract the following in regard to electrical materials:—

Imports of Electrical Materials into the Commonwealth.

	1900.	1903.	1904.	1905.
United Kingdom ...	£114,674	£178,336	£138,739	£141,484
British Possessions...	1,187	191	553	387
United States ...	41,667	35,670	14,994	18,844
Germany	24,407	32,118	28,859	39,657
Belgium	1,575	2,260	3,530	2,868
Sweden	5,720	100	—	91
Other Countries ...	3,328	340	2,771	2,395

The total for the foreign countries, as compared with the figures shown for the United Kingdom and British possessions, is given as £76,697 for 1900, £70,488 for 1903, £50,154 for 1904, and £63,855 for 1905. It is not apparent from the report whether dynamos, motors, transformers, &c., are included under the heading of electrical materials. If not, they will be comprised under machines and machinery, the value of which from the United Kingdom amounted to £1,044,000 in 1905, as compared with £1,102,000 in 1904; whilst the Australian imports from foreign countries, mainly the United States, were £662,000 in 1905 as against £615,000 in the preceding year. The Americans and Germans are making every effort to obtain a strong hold on the Australian market. As to the causes of the success of foreign competition, we may quote one in conclusion, namely:—"A German intending to open business with Australia goes out there and obtains specimens of every article of trade in his particular line of business; then he returns home, imitates the articles as closely as possible in every detail, and pushes them vigorously in Australia." Indeed, the Teutonic manufacturers are said to excel in the exact imitation of British goods, and as they consequently do not have to bear the cost of originality, they usually manage to quote a lower price and detach a certain amount of the trade.

The Constitution of Matter.

Section A of the British Association was much occupied with papers and discussions on the molecular constitution of matter, the constitution of the atom and its relation to the ether.

Prof. Rutherford gave a summary of recent theories on the constitution of the atom. To Faraday is due the original conception of the atom of electricity, which was further developed by Helmholtz. Starting from the work of Helmholtz, Larmor has developed the general theory of atomic constitution. From the purely experimental side, J. J. Thomson has shown that cathode ray particles were in reality negatively charged particles travelling at great speed, and that these particles consisted of very small quantities of matter compared with the hydrogen atom. The cathode particle or electron had an effective action over a very small distance, probably about ten times its diameter. One view of the nature of the electron was that it might be a state of strain in the ether. Lord Kelvin has suggested that the atom consisted of a number of electrons immersed in a sphere of positive electricity, and the suggestion has been developed by J. J. Thomson, who regarded the atom as a sphere of positive electrification, and suggested the possibility that the electrons were arranged in rings, which were temporarily stable. Positive electricity might be regarded as a kind of cement holding the atom together.

Lord Kelvin has now abandoned his theory that the ether is a fluid presenting appearances of elasticity due to motion. Abandoning this idea, he was driven to the conclusion that ether is an elastic solid, capable of equi-voluminal waves, in which the motive force is elastic resistance against change of shape. He has found it necessary to assume that ether is compressible, in order to account for the motion produced in ether by ponderable or electric atoms moving through it.

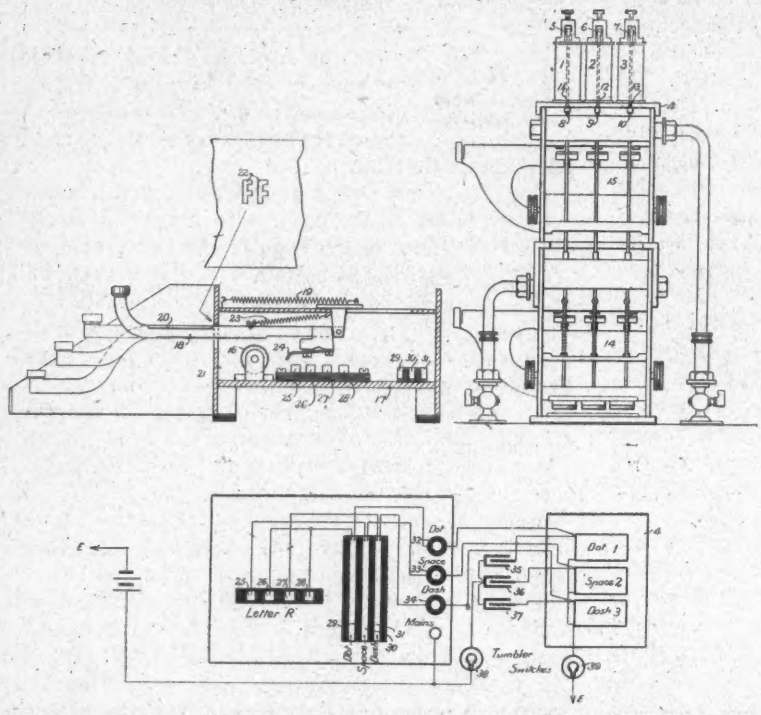
Lord Kelvin's theory of the constitution of the diatomic molecule is ingeniously simple. It seems, he says, that the persistence of the two-atom molecule in the common diatomic gases, O_2, N_2, H_2, Cl_2 is due to the impossibility of electrically-neutralising the ponderable atom by any integral number of "electrions." Suppose, for example, that one electron suffices to electrically neutralise two atoms of nitrogen. A monatomic nitrogen gas, if non-electrified as a whole, would have half its atoms without electrions, and, therefore, vitreously electric, with electric quantity equal and opposite to half that of a single electrion. Each of the other half of its whole number of atoms would have one electrion within it, and, therefore, its external force would be resinous with half the potency of a single electrion. Thus there would be a strong attraction between the atoms without electrions, and atoms each containing one electrion within it. This attraction would tend to bring the atoms together in pairs, N_2, each pair containing one electrion, of which the position of stable equilibrium would be at the middle of the line joining the centres of the two ponderable atoms.

Lord Kelvin does not believe in the modern theory that one kind of atom can be transformed into another kind of atom by disintegration. He considers that it is almost absolutely certain that there are many different kinds of atoms each eternally invariable in its own specific qualities.

D

KOTYRA KEYBOARD WHEATSTONE PERFORATOR.

Many attempts have been made in recent years, with more or less success, to devise a Wheatstone perforator actuated by a typewriter keyboard. The machines hitherto designed have involved the entire replacement of the perforators previously in use, but the most recent invention avoids the necessity for scrapping existing plant by applying a keyboard to manipulate the levers of the existing apparatus.



Figs. 1 and 2.—Sectional View of Apparatus, and Diagram of Electrical Circuits.

The inventor is M. Kotyra, of Paris. His apparatus consists of two essential parts—namely, three electromagnets and a keyboard. The combination can be used in conjunction either with an ordinary perforator or with a pneumatic puncher, the electromagnets being so applied to the plungers that, when actuated by the keyboard, they perform the work known as punching, at present done by hand or by air pressure.

The electromagnets 1, 2 and 3, figs. 1 and 2, are mounted side by side on a platform 4, and may be fixed over either a perforator or puncher as desired, so that the armatures 5, 6, 7 are in position above the plungers 8, 9, 10. Fig. 3 shows the electromagnets fitted in one case to a pneumatic set and in the other to an ordinary perforating set. Three steel rods 11, 12, 13 (fig. 1) are fixed to each armature, and project through the platform immediately above the dot, space, and dash plungers respectively. The attraction of an armature 5, 6 or 7 causes a downward thrust of the corresponding steel rod 11, 12 or 13, which in turn depresses the plungers 8, 9 or 10, causing the slip to be punched. Thus, if an impulse be sent through the electromagnet 1, a momentary thrust will be communicated to the dot plunger, if through electromagnet 3, a thrust will be given to the dash plunger, and if through electromagnet 2, the space plunger will be operated.

In fig. 1, the electromagnets are shown mounted over a pneumatic puncher for dealing with eight slips simultaneously, each perforator, 14 and 15, taking four slips simultaneously. By adding another deck and a third perforator, 12 slips can be simultaneously punched.

The keyboard has the universal arrangement of characters, but signals can be added to meet any special requirement. Plans of the machine are shown in figs. 4 and 5 (with one key selected), and a sectional drawing on the left-hand side of fig. 1, whilst the electrical connections are shown in fig. 2.

A pinion 16 (fig. 1), driven by a small electric motor of $\frac{1}{16}$ H.P., the speed of which may be conveniently regulated, is supported on the base 17 of the machine, and runs at right-angles to, and beneath, the whole of the key levers, one of which is represented by 18. Each lever has a rack cut on its lower surface to enable it, when depressed, to engage in the pinion 16, and each is mounted in such a manner that the revolving pinion causes the depressed lever to be thrust backwards in the direction of its length against the tension of the spiral spring 19. F-shaped slots are cut in the front plate 21, as shown by 22, to allow the levers to move to and fro, and a flange 20, of varying length according to the character, is fixed on each lever, so that when the rack engages with the pinion, the flange enters the lower horizontal slot and is maintained in contact with the pinion until the whole of the flange has passed through the plate 21. The spiral spring 23, which is always exerting an upward pull, then causes the lever to disengage from the pinion, and when the flange enters the upper horizontal slot, the lever is smartly retracted and restored to its normal position by the strong spring 19. Fixed to each lever in the position shown is a trailer-spring 24, which is drawn over a series of metallic studs 25, 26, 27 and 28, insulated from the frame but electrically connected to one or other of the electromagnets 1, 2, 3, *via* the brass strips 29, 30 and 31, and the terminals 32, 33 and 34 (fig. 2), so that the trailer in passing over a stud completes a local circuit and causes a momentary current to flow through the coils of the particular electromagnet to which the stud is connected.

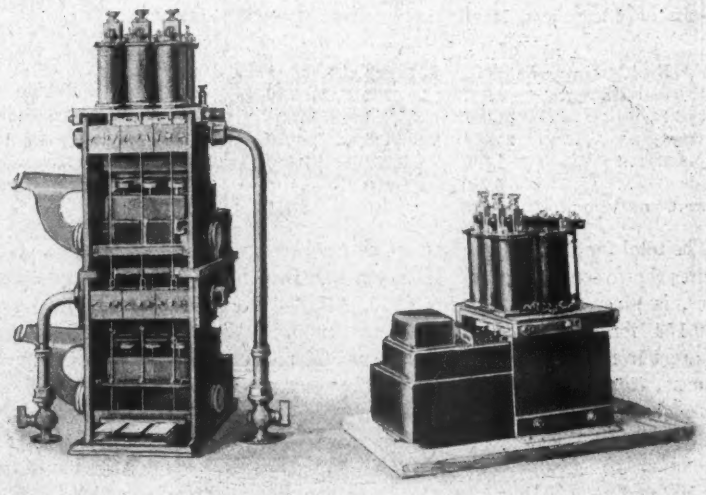


Fig. 3.—Electromagnet Fitted on Pneumatic Puncher and Ordinary Perforator.

Condensers 35, 36 and 37, each of $\frac{1}{2}$-microfarad capacity, prevent sparking between the trailer and the studs, and switches 38 and 39 disconnect the mains when the apparatus is out of use. A separate series of studs is allotted to each

lever, the number in each series corresponding to the number of signals in the character represented by the key-lever. In each case an extra stud is inserted to operate the space key before commencing any symbol, *e.g.*, in the case of the letter R, a group of four contacts, as shown in figs. 1 and 2, would be necessary, the first being connected to the space electro-

Fig. 4.—Plan of Keyboard.

magnet, the second to the dot electromagnet, the third to the dash electromagnet, and the fourth to the dot electromagnet. Thus for a single depression of the letter R on the keyboard, four blows following in rapid succession would be communicated to the plungers. For any numeral six blows would be struck.

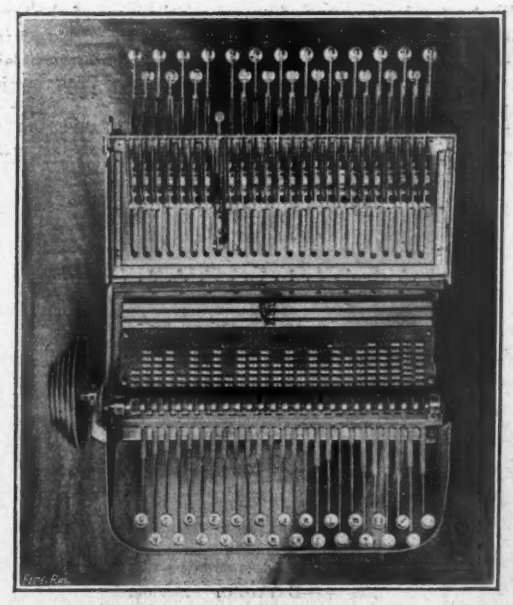


Fig. 5.—Plan of Keyboard, Open.

A number of perforators may be operated from a single keyboard by merely duplicating and connecting up additional sets of electromagnets and perforators, so that a large number of multiple slips are readily obtainable.

Thermit Welding.—The Dundee City Tramways have specified the use of the Thermit joint in connection with the tramway extension they are carrying out at present.

RECORDS AND DRAWINGS OF ELECTRIC MAINS.

By W. MAYALL MILNES.

The different methods adopted by electricity supply undertakings in this country for keeping records of their mains, are almost as numerous and varied as those undertakings themselves.

Some of these methods are efficient, but expensive, some are cheap and more or less useless, while some are both inexpensive to maintain and at the same time efficacious. This article is a short description of a system recently adopted at the Burnley Electricity Works, Lancashire, which has proved itself inexpensive to compile and keep up to date, and at the same time thoroughly complete without being complicated.

The method in use during the earlier stages of the undertaking was simple, and in those days of only a small output over a small area, was quite satisfactory. Copies of the ordnance survey maps of the supply area were obtained, and on these were filled in the feeders, distributors and services in different colours. These ordnance survey maps are on a scale of 41·66 ft. to an inch, and measure about 3 ft. 6 in. × 2 ft. 3 in. It requires about 45 such maps to cover the whole of the borough.

As the consumers were practically confined to the tradesmen in the main streets of the centre of the town, three or four of these sections were sufficient to cover the area supplied, and this method, in conjunction with a consumer's book giving particulars of installations, formed a handy and sufficiently complete index of the mains.

The electricity supply undertaking in Burnley, as in most other busy manufacturing towns, has grown very rapidly, and instead of an equivalent of 27,050 8-c.p. lamps and 59 h.p. of motors on the mains in 1900, it has now an equivalent of 51,588 8-c.p. lamps and 620 h.p. of motors connected. This increase has, of course, resulted in a great measure from extensions to the mains, and where in 1900 there were 13 miles of cables laid, there are now 21 miles, an increase of 61·5 per cent. These extensions to the mains have carried the supply area in ever-widening circles further and further from the centre of the town, until now it reaches the borough boundaries in every direction.

The old method of keeping mains records, at the present moment, would entail the use of practically the whole of the 45 ordnance survey sections, or if they were pieced together, a map 28 ft. square, and as can readily be imagined, this would be anything but a handy arrangement. Although even latterly it did not seriously inconvenience the older members of the staff, who had seen the bulk of the cables laid, it was a very complex and inconvenient system when changes took place on the staff, and new men came in, for in order to trace a single feeder or distributor, as many as a dozen maps had to be consulted. Though the system was eminently suitable for the requirements of the department during its earlier days as a small concern, it was found to be entirely inadequate for the large area now supplied. The scheme here described was drawn up and carried out by Mr. J. E. Starkie, the borough electrical engineer, and his staff, in 1906.

Perhaps it will be more clear if a short description of the system of supply in vogue at Burnley is first given. Current is supplied on the three-wire system with 440 volts across the outers. The town is divided into seven sections, for each of which a separate feeder is run from the generating station. Five of these sections are isolated, and the remaining two form a ring. The current is taken through switches and fuses at the station, and through the feeders to street pillars at the best distributing points in each section or district. These pillars are Downe & Black's patent circular pattern, with revolving covers, and they were made and supplied by the British Insulated and Helsby Cables, Ltd., Prescot; a view of one of them in position is given in fig. 1, p. 250, and fig. 2 shows a complete pillar, with and without the cover.

In the pillars, current comes in through the feeders and links to copper bus-bars, and from the bars through tubular fuses to the distributors. All cables coming into the pillars are lead-covered and armoured three-core, and the pillars are earthed on to the lead of the cables.

The distributors from each feeder pillar are further fused at different points, namely, those points at which they connect up to the distributors from adjacent feeders, and in the case of the more dense areas, the distributors themselves, where they couple up to adjoining distributors in their own area, are connected through straight-through fuse boxes. When these fuse boxes were put in, care was taken to find

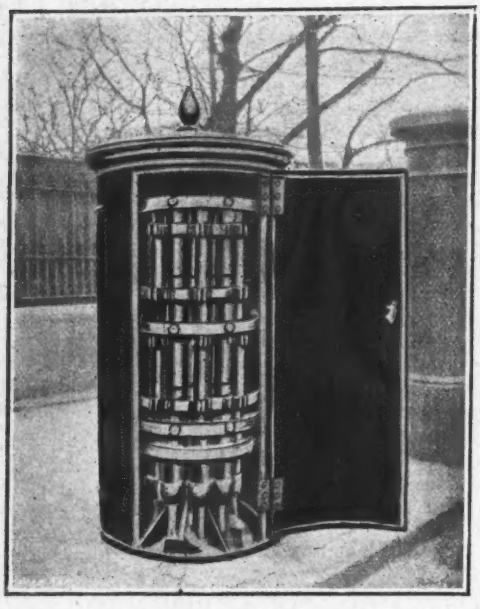


Fig. 1.—Downe & Black Feeder Pillar.

those points on the distributors at which the current flowing was a minimum, being only the balancing currents between adjoining feeder or distributor areas. The fuses at these points (which need only be light) in the event of a fault, are immediately blown by the rush of current from the sound

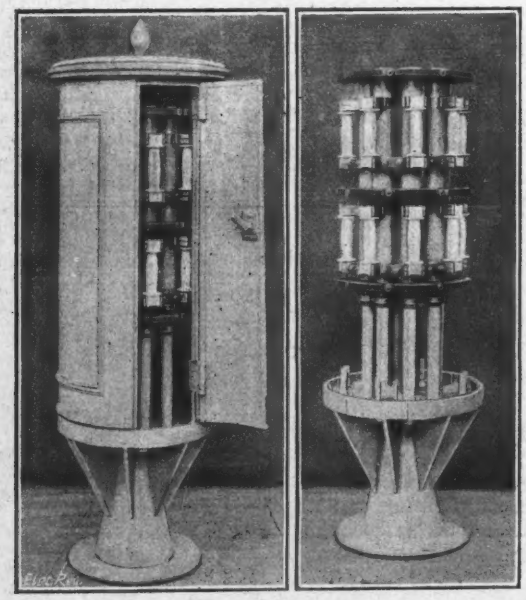


Fig. 2.—Feeder Pillar with and without Cover.

mains to the fault. The faulty feeder area is thus isolated, or if the fault be on a distributor, its fuse in the feeder pillar blows, and the fault is localised into a small area without affecting any other portion of the network beyond a momentary slight jump in pressure.

These light interconnecting fuses were also supplied by the British Insulated and Helsby Cables, Ltd., and are of their standard type. They are placed underground in cast-iron boxes, in brick pits with pavement frames and covers, accessibility not being of such importance as in the case of the main distributor fuses.

This arrangement has worked excellently, and has prevented serious, or even complete, shut-down on more than one occasion since it was installed a year ago.

In addition there are link boxes at various points on the distributors to facilitate repairs. This will be a sufficient description of the network, &c., to illustrate the method employed of keeping the records.

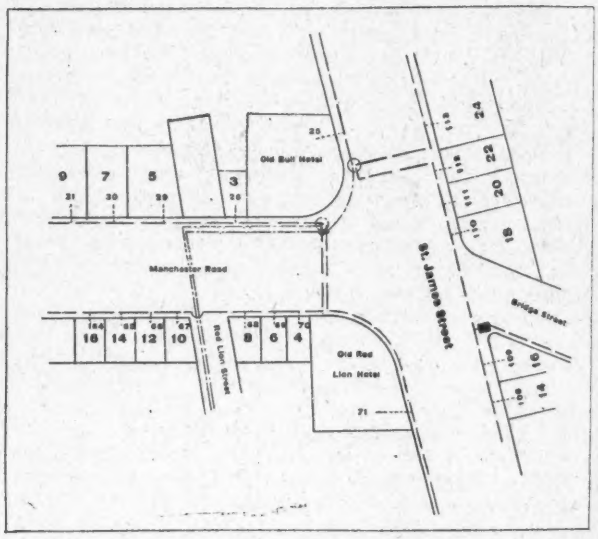


Fig. 3.—Section of Map.

Feeders —·—·—; Distributors ——— ——— ———; Services ····

First, a tracing was made from an existing map of the town, 550 ft. to an inch, making a map 3 ft. 6 in. × 2 ft. 3 in., with only those streets filled in where mains were laid. On this map only distributors were filled in, each section supplied by a feeder being shown with a different colour, so outlining at a glance what portion of the town would be affected by a fault on any particular feeder. For details of

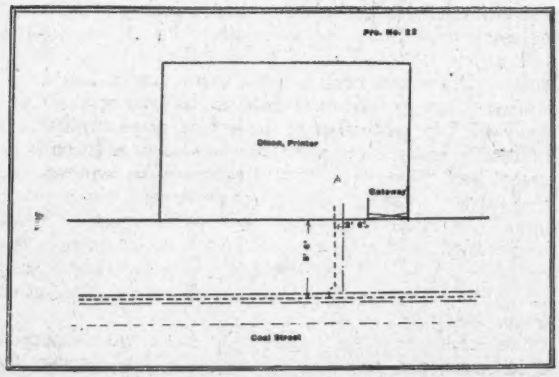


Fig. 4.—Detail of Service.

distributors a much larger map was deemed necessary, and as the town stretches out with four long arms, it was decided to make one large map to include the whole of the central and thickly populated area, and one smaller one for each of the four arms.

The next step was to get such maps of suitable dimensions, and as it was found impossible to procure them ready made, the mains staff set to work, and with the aid of an eidograph made reduced maps from the ordnance survey maps to the required scale (84 ft. to an inch), pieced the different sections together, and traced them off on strips of tracing cloth. These strips were then sent to be mounted on strong cloth

and rollers, and the result was one large map, 8 ft. × 4 ft., and four smaller ones ranging from 3 ft. × 4 ft. to 1 ft. 6 in. × 2 ft.

On these, the feeders, distributors, services, feeder pillars, fuse boxes, and link boxes were then filled in: feeders and feeder pillars in red, distributors and fusing boxes in blue, and link boxes and services in green. Fig. 3 shows a section of this map with feeder pillar, feeder, distributors and services, with the street number of the house in black, and the service number in green.

This map, however, is not sufficiently large to include sufficient details of services, so each service is shown by a green line running from the distributor into the consumer's premises, and a number, and for a more detailed record of services the following method is employed.

When a service is being put on, an apprentice goes out with the mains engineer, while the ground is open, and makes a sketch of the distributors and service cables, marking carefully the exact position of the joint boxes, by taking dimensions of the distance they are from the curb, and the premises in line with them, the spot where the service enters the premises, and the distance this spot is to the right or left of some landmark, such as a doorway or cellar window, the depth at which the cable is buried, total length of service cable, maker, size and class of cable, and particulars of any feeders or other cables, gas, water or drain pipes in the vicinity of the service. On returning to the works the pupil makes a neat ink copy of this sketch as in fig. 4, marking the distributors with red for positive, yellow for middle wire, and blue for negative, and using the same colours for the service whatever it may be, red and yellow for a positive service, blue and yellow for a negative, or red, yellow and blue for a three-wire service, such as large motor or church services, thus making a small map measuring 6 in. × 4½ in., and then gives the service a progressive number. This sketch is done on tracing cloth to make it more durable, and is folded two or three times, and pasted in an indexed book, similar to that usually employed for pasting accounts in, and underneath are written the particulars already gleaned, with any peculiarities that may occur, and the service and number filled in on the large maps. Pillars, fuse boxes, link boxes and all faults are treated in a similar manner. In addition, a "consumers'" book is kept, with the name and address, description of premises, service number, polarity and particulars of installation of each consumer set out in tabulated form.

The maps are hung on the walls of the mains engineer's office, and the books are kept in his office, so that he can readily refer to any and all of them.

The advantages of this scheme are fairly obvious. For example, an application is received for a service; the mains engineer looks up his map, and sees whether the nearest point at which the mains are laid is a distributor or service cable. If a service cable is much nearer than a distributor, as often occurs in residential districts, he looks up the "Service Book" for particulars of the service, notes whether it is sufficiently heavy to carry the new service in addition to its present load, if so, what class of cable will be required, and what length of cable will be necessary to reach the new consumer. So that though he may be a new man, he is not handicapped by having to make inquiries off more or less forgetful juniors and jointers, but knows at once exactly what he will find, and where to find it when he goes out on service laying.

The scheme is simple, easily understood and inexpensive to construct and keep up to date, as a pupil (under the supervision of the mains engineer) does all that is required after the maps are made, and it is thoroughly complete and self-contained, all of which are essential points in any scheme for keeping records of the mains of an electricity supply undertaking.

The Australian Customs Tariff Changes.—The following are the principal items, as regards the electrical industry in the British preference tariff proposals, which have just been submitted to the Federal Parliament by Sir Wm. Lyne, on behalf of the Australian Commonwealth. The first figures show the general tariff, and the second the proposed tariff on British goods:—Electrical generators and motors up to 500 H.P., fans, and starting and regulating rheostats, 30 per cent.; 25 per cent. Others, 17½ per cent.; 12½ per cent. Electrical materials, 5 per cent.; free.

CORRESPONDENCE.

Letters received by us after 5 p.m. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Regenerative Control.

This is the season apparently of bad accidents on tramways, and therefore the season again to bring before your readers, and especially tramway authorities, the benefits of regenerative control, with its powerful and neverfailing braking force. Frankly, Sir, I do not understand tramway engineers and managers neglecting the advantages of the system. I have always considered them the most enterprising in electrical engineering or any other engineering profession, and here we see them fighting shy of a method of safe handling and control that is not only second to none, but is far and away immensely superior to any other system.

As I pointed out in one of my letters some time ago, mechanical methods of braking may fail, and have failed, but the motor method of braking on the regenerative system is as likely to fail as a car is likely to leave the rail when going dead slow on a straight line.

I must again express a hope that tramway authorities will take this system up in earnest and secure the advantages to be derived from its adoption, and also the safety control, which is the main consideration.

John I. Hall.

London, W.C., *August 10th*, 1907.

I.M.E.A. Convention.

With reference to your criticisms of the curve, fig. 1, in Mr. Burnett's paper, may I, by way of pouring oil on troubled waters, suggest that you refer to Mr. Arthur Wright's paper on "Some Principles Underlying the Profitable Sale of Electricity," read before the Institution of Electrical Engineers in December, 1901. In this paper, Mr. Wright describes fully the method of determining the standing charges and running costs by means of a curve similar to that given by Mr. Burnett. Also refer to Mr. Taylor's paper on "Standby Charges and Motor Load Development," read before the Birmingham Local Section of the I.E.E. in December, 1904 (see *Journal*, Vol. 35), where the same method is used for determining the running as apart from the standing charges.

I have used this method myself, and, personally, I think the figures given by Mr. Burnett were sufficiently accurate for all practical purposes.

It is possible to arrive at the same result by means of figures, as the following extract from a paper by Mr. Arthur Wright (I believe his Presidential Address at the 1896 Convention of the M.E.A.) will show:—

"Of the above items constituting the running and standby costs, the only ones which are not capable of being at once debited to the proper division are the coal, stores and repairs of plant; but the first two of these can be very fairly divided by the use of the following simple method, which its accompanying formula will explain and justify.

"Let T represent the total expenditure on these items during one month or period of time when the sale of electricity U is great, and T that for another period of preferably the same year when the sale U′ is much less.

"Let S be the cost of the two items, coals and stores, which have to be used during each of the two periods on account of having to get ready and to stand by, and R the running cost per unit it is desired to determine.

"Then by the definition, as

$$T = S + R \times U,$$

and

$$T' = S + R \times U',$$

then

$$T - T' = R \times (U - U'),$$

therefore

$$R = \frac{T - T'}{U - U'}, \text{ and } S = T - R \times U \text{ or } T' - R \times U',$$

or the average cost per unit of continuing to supply electricity during these two periods is the difference of the

total expenditures divided by the difference of the sales in the two periods."

This method refers to two periods only, whereas by the use of the curve the average of any number of periods can be very easily obtained.

W. A. Vignoles.

Electricity Works, Grimsby,
August 2nd, 1907.

[We are indebted to Mr. Vignoles for his explanation of the method used by Mr. Burnett for ascertaining running costs as apart from standing charges. We anticipated that some such method had been used, but we took exception to the statement that "the figures obtained from these quarterly balance-sheets (?) *are plotted as in fig.* 1," when the figure merely represented the annual sum of £8,968 ÷ 4 plus £125 for every 50,000 units output; a bald statement of figures without a plot of any description shown, which, when given in diagrammatic form, had no more significance than the mere figures themselves.

But now that we have got at the foundation of the matter, and at the risk of being considered heretical, we wish to record that we are not in agreement with some of the principles laid down by Mr. Wright in the days gone by. We fully appreciate the value of that gentleman's work to the electric lighting industry, but we do not think that such methods apply to present-day conditions; the famous "maximum-demand system" is being gradually discarded with the growth of power supply, and although no definite law has been adopted as a basis for equitable charging for the supply of energy, it is felt that a drastic change is required. Surely the time has now arrived when we may look upon lighting as only a branch of the industry, and, when dealing with modern methods of ascertaining costs of supply, it is correct to treat it as such. If so, then we put it to electrical engineers that the stand-by losses of the modern power supply undertaking are not materially greater during the period of lighter sales than during that of the greater sale of energy. We would also urge that stand-by losses, as well as transformation and other losses, should come under the category of running costs. As we pointed out to Mr. Burnett, smaller, and consequently less efficient, generating sets, are used during a light load, and probably the running plant load factor also suffers, and there can be no doubt as to the nature of the loss thus sustained.

We think it quite possible to allocate all expenditure correctly, provided a definite system is followed out, and as we consider it probable that the future basis of charge for supply will be the true running cost per unit for energy consumed as per meter, whilst standing charges will be recouped by assessment or rental, it is highly important that a definite system should be arrived at for accurately separating these costs. It is with this end in view that we have expressed ourselves, rather forcibly perhaps, against the present antiquated and crude methods of recording costs. We trust the matter will not end here, and we invite all engineers interested in the future of the industry to express their views, for publication or otherwise, as it is only by interchange of opinion that a successful system can be established.—Eds. E.R.]

Electricity Supply Accounts.

In your article appearing in the Electrical Review of the 26th ult., you state that all the Metropolitan Boroughs have kept their electricity accounts on the "receipts and payments" principle on the instruction of the Local Government Board auditor. Such a statement is not, I fear, founded on facts, as the accounts of this undertaking, in company with many others, for the past few years have been prepared on the "income and expenditure" basis, and show, therefore, the real financial position for any complete year. All accrued income and expenditure is included at the close of each financial year, and where consumers and trade discounts have not been allowed, they are calculated and shown in full.

Regarding your remarks on depreciation, there is no reason why it should be confounded with repayment of loans, but the conditions to be met make it imperative that both should be considered together, since there is no getting away from the fact that at the end of the loan period, the two must be made to coincide, assuming that new loans are to be raised for future plant; this has never yet been seriously disputed, though we are occasionally told that we must provide a fund equivalent to our current loans, so that the undertaking will be free from debt from 25 to 42 years hence.

It is, of course, highly desirable that the value of the plant should be depreciated annually, by the repayment of loans or writing down, but if the life is estimated in advance to obtain the rate of depreciation, why not raise the loan for the same period? I do not suggest that in the case of loans already taken up for a period of 42 years, repayments should be adjusted on the 25-year basis under present conditions, but it seems probable that with future loans raised for short periods, depreciation will become merely a book-keeping entry; in other words, the time for which the loan is raised will more nearly represent the life of any particular apparatus, which is the real point at issue.

With a substantial reserve fund once created and maintained, there will be no difficulty in dealing adequately with the question of depreciation or obsolescence by the simple process of writing off the outstanding balance of the original loans standing to the debit of discarded plant.

Much has been written on the question of depreciation lately, but what seems to be more than ever necessary is a consistent and continuous policy in the management of electrical undertakings, free from drastic changes.

The change from the annuity system of loan redemption to the instalment principle, will affect but few undertakings. I believe the majority of their loans have been raised on the latter system, and the Electricity Committees of the Metropolitan Boroughs do not at present seem disposed to upset the existing arrangements for repayments for money already borrowed, nor would they, I fear, grant new bonds for outstanding debt at the current rates of interest, as the relief would be temporary only.

The question of a quarterly balance is a matter that deserves more attention than it usually gets; in my own case the result is extremely useful for comparative purposes, though somewhat belated, owing to the difficulty in getting prime cost work up to date quickly enough to check current expenditure.

D. M. Kinghorn.

Southwark Electricity Works,
August 7th, 1907.

[In making the statement that the electricity accounts of all Metropolitan Boroughs were *based* upon the principle of "receipts and payments," we did not intend to convey the idea that they were kept upon this principle "in toto," but to a sufficient extent to make an appreciable difference when changed over to the complete "income and expenditure" principle.

We are glad to learn that the Southwark undertaking has been financed for some years past upon the latter principle, but we can assure Mr. Kinghorn that such is the exception and not the rule, and we must be allowed to question his statement that many of the Metropolitan Boroughs do likewise.

We disagree with the statement that depreciation and loan redemption must be made to coincide at the end of the loan period. At the end of 42 years it is highly probable that the only original assets of any value will be the permanent portion of buildings and land, and if the obligation upon which the loans are granted is carried out, the whole of the remaining assets will have been replaced, out of revenue. It is futile to remark that new loans can be raised for future plant when the obligation referred to applies to all loans raised by Metropolitan authorities, which, if enforced, will leave the undertakings free from debt at the end of the loan periods, a Utopian idea it is true, and financially absurd. The capital or book value of the assets should be the true value constantly, but we maintain that in the early period of its existence it is not practicable for any undertaking to maintain this by the method of repayment of loans; a system such as we referred to in our article fully meets the exigencies of the case.

Mr. Kinghorn suggests that no steps should be taken to provide against depreciation of capital already spent on the

forty-two years' redemption system. Probably in the case of Southwark, where the capital commitments have not assumed very large dimensions, the effect in the years to come would not be seriously felt by the ratepayers, but when applied to boroughs like Islington and St. Pancras, where the capital expenditure is five and six times greater, the matter is of serious moment.

We are pleased to note the statement, "What seems to be more than ever necessary is a consistent and continuous policy in the management of electrical undertakings, free from drastic change." We approve of the principle in its entirety, but we would point out that it is necessary to lay down a policy that is fundamentally correct, that provides for the future in the same measure as the present, and which will also retrieve the errors of the past, and it is in the establishment of this policy that we are endeavouring to interest engineers by the publication of such articles as that commented upon by our correspondent.

Mr. Kinghorn entirely misconstrues our idea in advocating a re-issue of bonds for outstanding debt. We suggested that the new bonds should be at the respective rates of interest or one bond with equated interest; no reference was made to current rates.

We should like to have Mr. Kinghorn's authority for the statement that "the Electricity Committees of the Metropolitan Boroughs do not at present seem disposed to upset the existing arrangements for repayments for money already borrowed." In the first place, this is not a matter for the decision of Electricity Committees, who would not be expected to do more than comment upon the subject, leaving the discussion and recommendation to the Finance Committees; and, in the second place, we have it from an authentic but unofficial source that the L.C.C. is now prepared to grant loans upon a quarterly repayment system. Surely if this principle can be applied to the future, it may be made retrospective by some such system as that advocated in our article of the 26th ult.

We sympathise with Mr. Kinghorn in his closing remark, *re* belated prime cost work. We have felt that this is a matter that demands immediate attention and redress, and we trust that Mr. Kinghorn will be an interested reader of our articles now appearing, dealing with the subject.—Eds. E.R.]

Inductor Alternator Design.

Some years ago I devised an inductor alternator in which there was to be but one armature coil. The idea is illustrated in fig. 1, which shows laminated field-magnet poles N N, S S, and a laminated zigzag or wave form of inductor I, the continuous relative motion of which would cause alter-

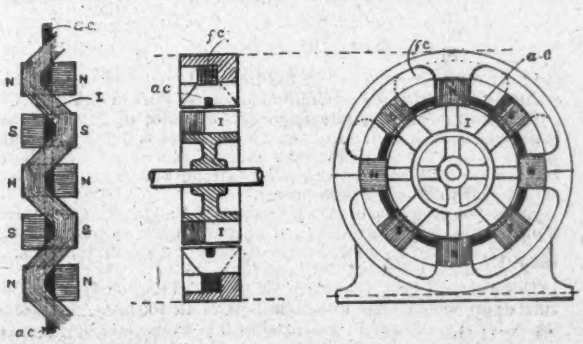


Fig. 1.

Fig. 2.

Fig. 3.

nating currents to be generated in the armature coil *a c*. Figs. 2 and 3 show one form such an alternator might take.

So far as I am aware, this idea of employing a wave form of inductor and a single armature coil is novel, and it might be of interest to some of your readers.

Ad. H. F.

Holywood, *August 12th*, 1907.

Address Wanted.—A Correspondent wants to know the address of the British Automatic Alarm Bell Co., Ltd.

THE BRITISH ASSOCIATION MEETING AT LEICESTER.

The Density of the Ether.

By Sir Oliver Lodge, F.R.S.

(*Section A.*)

1. The theory that an electric charge must possess the equivalent of inertia was clearly established by J. J. Thomson in the *Philosophical Magazine* for April, 1881.

2. The discovery of masses smaller than atoms was made experimentally by J. J. Thomson, and communicated to Section A at Dover in 1889.

3. The thesis that the corpuscles so discovered consisted wholly of electric charges was sustained by many people, and was clinched by the experiments of Kaufmann in 1902.

4. The concentration of the ionic charge, required to give the observed corpuscular inertia, can be easily calculated; and consequently the size of the electric nucleus, or electron, is known.

5. The old perception that a magnetic field is kinetic has been developed by Kelvin, Heaviside, FitzGerald, Hicks, and Larmor, most of whom had treated it as a flow along magnetic lines; though it may also, perhaps equally well, be regarded as a flow perpendicular to them and along the Poynting vector. The former doctrine is sustained by Larmor, as in accordance with the principle of least action, and with the absolutely stationary character of the ether as a whole; the latter view appears to be more consistent with the theories of J. J. Thomson.

6. A charge in motion is well known to be surrounded by a magnetic field; and the energy of the motion can be expressed in terms of the energy of this concomitant field—which again must be accounted as the kinetic energy of ethereous flow.

7. Putting these things together, and considering the ether as essentially incompressible—on the strength of the Cavendish electric experiment, the facts of gravitation, and the general idea of a connecting continuous medium—the author reckons that to deal with the ether dynamically it must be treated as having a density of the order 10^{12} grammes per cubic centimetre.

8. The existence of transverse waves in the interior of a fluid can only be explained on gyrostatic principles, *i.e.*, by the kinetic or rotational elasticity of Lord Kelvin. And the internal circulatory speed of the intrinsic motion of such a fluid must be comparable with the velocity with which such waves are transmitted.

9. Putting these things together, it follows that the intrinsic or constitutional vortex energy of the ether must be of the order 10^{33} ergs per cubic centimetre.

Conclusion.—Thus every cubic millimetre of the universal ether of space must possess the equivalent of 1,000 tons, and every part of it must be squirming internally with the velocity of light.

The New Engineering Laboratory at the City and Guilds of London Institute, Finsbury.

By Prof. E. G. Coker, M.A., D.Sc.

(*Section G.—Abstract.*)

The recent extension in the Department of Mechanical Engineering at the City and Guilds Technical College, Finsbury, has been provided for by the City Companies, aided by a private donor.

A new wing has been added to the College, in which accommodation has been found for an engineering laboratory, drawing offices, lecture and preparation rooms. The principal feature of interest is the engineering laboratory, of about 4,000 sq. ft. in area, on the basement floor. A part of this laboratory has been devoted to hydraulic equipment, which is mainly grouped with reference to a cast-iron channel, 80 ft. long, and of square section 2 ft. side. At one end of this is a space for a vertical pressure cylinder, for experiments on jets, impact on vanes, and the like. At the other end are measuring tanks, of a total capacity of 3,500 gallons, into which the water drains after passing over a weir in the main channel. There are also two subsidiary channels, parallel to the main one, and draining directly into the measuring tanks. The water after use is raised to a roof tank of 5,000 gallons capacity by a centrifugal pump of 200 gallons capacity per minute, and it is returned to the laboratory by a falling main for use anew.

The hydraulic machines already installed comprise an inward-flow pressure turbine, an outward-flow Girard turbine, a Worthington pump, a three-cylinder hydraulic engine, and a considerable amount of other apparatus for experimental work.

The heat engines are all of moderate size, and are in most cases of special design for experimental work. A gas engine of 12 H.P. is fitted for work with either town gas or suction gas from a Dowson producer. A refrigerating plant is arranged to work with either carbonic acid or ammonia by using interchangeable cylinders. An oil engine, hot-air engine, steam engines, and a compound air-compressor are also installed, while space has been left for future developments.

The equipment also includes a 10-ton Buckton testing machine and a varied collection of other apparatus for testing materials.

The drawing office has accommodation for 100 students, and is divided by a glazed partition for convenience in teaching. The workshops have been entirely remodelled, and nearly all the old machine tools have been replaced by new ones. A new lecture theatre seats 100 students, and is fitted with the necessary appliances for experimental and lantern demonstrations.

The Ice Problem in Engineering Work in Canada.

By Howard T. Barnes, D.Sc., F.R.S.C., Associate Professor of Physics, McGill University, Montreal.

(Section G.)

In Canada the physicist has excellent opportunity to study on a grand scale the operation of the natural laws governing the formation of ice in the many forms met with in the large and often turbulent rivers. To the engineer the problem is more serious, for the development of the vast water-powers of the country must include means for combating the ice troubles which arise each winter. The conditions which must be met during the winter months are sometimes very serious, when ice is forming rapidly, and ice bridges, dams and shoves may change the whole character of the levels and channels in a single night. Rivers are known to have been turned entirely out of their course to seek new channels during a winter of unusual severity, and in some instances the reversal of a rapid is of yearly occurrence. Nowhere can one witness a more wonderful sight of the delicate poising of the forces of Nature than in one of the Canadian rivers in winter. The steadiness of the temperature of the water throughout the ice season is a matter of great interest. It seldom varies more than a few thousandths of a degree from the freezing point even in the severest weather. This is true for rivers flowing too swiftly for surface ice to form, as well as for the quieter streams protected by an ice covering.

In general three varieties of ice are distinguished, and present characteristics brought about by their method of production. Surface or sheet ice forms over the surface of quiet lakes or rivers, and is helpful or not, depending on the particular conditions. Spicular ice, or, as it is called in Canada, frazil-ice, is formed by surface agitation in the more turbulent rivers and in waterfalls, and accumulates in great quantities in the quieter portions of the stream, where it is carried by currents. It varies in size from thin plates to fine needle crystals, depending on the degree of agitation of the water, and of all the forms of ice, it gives the most trouble in hydraulic work. Anchor or ground ice is the most interesting form on account of the fact that it grows along the bed of a river which is not covered by a surface sheet. It is formed in two ways: by the cooling of the bottom by the radiation of heat during cold clear nights, and by the freezing of frazil-ice carried down by the currents of water when in a supercooled state. A bright sun has a great influence on the ice, and as soon as its rays are sufficiently high to penetrate to the bottom, the ice is detached and rises to the surface. In so doing it frequently brings up stones or boulders of considerable size to which it is attached.

A study of the temperature conditions in the water during the production of these forms of ice shows that the freezing is accompanied by a small temperature depression in the water, amounting to a few thousandths of a degree from the freezing point.* During severe cold weather the water is thus thrown into a slightly supercooled state, during which time the ice crystals grow rapidly by continued freezing, and give rise to the agglomerating stage, when they possess adhesive properties and form lumps and spongy masses. In this condition the ice is dreaded by power users, for it quickly adheres to the rack-bars and to the machinery of the wheel-gates and turbines. In a short time it interferes with the operation of the wheels, and may at any moment cause a temporary cessation of operations. Fortunately, it is only a minute temperature depression which brings about these conditions, and methods of artificial heat applied about the affected spots relieve the situation in a short time. An intelligent use of artificial heat, specially at night time when supercooling is most common, is found valuable in preventing any interference with the normal operation of a power house. It is not necessary to warm the entire volume of water passing through, which would be very costly and difficult; but by applying the heat in the racks or wheel cases, or blowing steam about the affected parts, the ice is prevented from obtaining a foothold. The ice is as effective as so much water in producing a head, hence the necessity of passing it through, and never allowing it to freeze to the metal surfaces of the machinery. It is safe to say that where it is possible to apply even a small quantity of heat directly to the machinery and racks, a condition of affairs may be done away with, which for many years has been regarded as involving inevitable interruption to the continuous operation of a plant.

There are other causes at work, however, to interfere with the operation of power plants, which depend on the particular spot where a power house is located. Rivers like the St. Lawrence at Montreal are subjected to winter floods, occasioned by the accumulation of frazil and disintegrated anchor ice. Wherever open water or a rapid occurs above a surface sheet of ice, large quantities of frazil-ice are carried under by the currents, and settle upwards in the quieter parts. Large hanging dams of spongy ice are thus produced, which so reduce the available waterway as to cause serious changes in level. Sometimes the channels become blocked entirely, and then the water backs up sufficiently to clear the ice away and produce a shove. A tremendous upheaval results, and large masses of ice are piled on high for miles around, often doing much damage.

It is well known that the most effective prevention to the formation of both frazil and anchor ice is the protection afforded by a surface sheet of ice. If a power house is located on a river normally frozen over, with no stretches of open water above, no ice troubles are experienced. When this is not possible, artificial intake canals are usually constructed, in which the water flows sufficiently slowly to freeze over. If the canal is fed from the open river, booms and crib-work are resorted to in order to deflect much of the ice. If the inflowing water current is sufficiently rapid to draw the frazil under the surface ice, it is often necessary to cut artificial channels to allow of sufficient water for the wheels. Thus a surface sheet may prove to be disadvantageous. So many and varied are the conditions to be met with in the location of a power house, that no set of rules can be given to meet the general case. It is only by a thorough knowledge of the laws underlying the formation of ice that means may be found to cope with any particular situation. It may safely be said, however, that the ice problem in Canada is no bar to the future development of her vast water powers.

* Cases are known, however, where anchor-ice was formed by copious nocturnal radiation when the water was slightly above the freezing temperature.

Electrical Standards.

Experiments for Improving the Construction of Practical Standards for Electrical Measurements.—Report of the Committee, consisting of Lord Rayleigh *(Chairman)*, Dr. R. T. Glazebrook *(Secretary)*, Lord Kelvin, Profs. W. E. Ayrton, J. Perry, W. G. Adams, *and* G. Carey Foster, Sir Oliver J. Lodge, Dr. A. Muirhead, Sir W. H. Preece, Profs. A. Schuster, J. A. Fleming, *and* J. J. Thomson, Dr. W. N. Shaw, Dr. J. T. Bottomley, Rev. T. C. Fitzpatrick, Dr. G. Johnstone Stoney, Prof. S. P. Thompson, Mr. J. Rennie, Principal E. H. Griffiths, Sir A. W. Rucker, Prof. H. L. Callendar, *and* Mr. George Matthey.

(Section A.)

The main work during the year has been the completion of the work with the ampere balance. The general results are referred to in some detail below. The final measurements confirm the opinion expressed in last year's report, that an accuracy of a few parts in 100,000 might be reached. It appears that the result is probably accurate to 1 in 50,000.

Interim reports on the ampere balance, indicating the progress of construction, adjustment, and use of the instrument, have been submitted to the Association since 1904.

The Committee are now pleased to report that the balance continues to give complete satisfaction. During the past year it has been much used for determining the E.M.F. of the normal Weston cadmium cell and the electrochemical equivalent of silver. A description of the instrument, its construction and adjustment, and the results obtained with it in the cadmium cell determinations, has been prepared and submitted to the Royal Society for publication in its *Transactions* by Prof. Ayrton, Mr. Mather, and Mr. F. E. Smith. An account of the work on the electrochemical equivalent of silver is well advanced and will be published shortly.

In all some 71 observations have been made on a certain cadmium cell (No. 2), using both sets of coils on the balance, and 13 observations in which one or other of the two sets was employed. The agreement between the individual results obtained with the two sets of coils is remarkable, the average difference from the mean amounting to only six parts in a million. The whole series of observations extended over a period of 19 months (September, 1905, to April, 1907), and during that time the coils of the balance were reset five times. No determination made has been omitted except those in which the observations were of such a nature that a decision to disregard the result was arrived at before its computation. Such occasions were rare.

Of the 71 observations made

7	are within	1	in a million of the mean.	
14	,,	2	,,	,,
28	,,	5	,,	,,
53	,,	10	,,	,,
66	,,	15	,,	,,
70	,,	20	,,	,,

Only one determination out of the whole 71, and this one of the earliest, differs from the mean by so much as 1 part in 59,000.

The above facts constitute important evidence of constancy in both balance and cell. In fact, both current weigher and cell proved to be much more constant and reliable than the standard resistance, although the latter was very carefully made and annealed with a view to ensuring permanency.

Expressed in terms of the international ohm as realised at the National Physical Laboratory, and of the ampere as given by the new current weigher, we find that the value of $C \times B$ for the normal Weston cadmium cell is $1{\cdot}01830_5$ at 17° C.

This assumes that the value of g at Teddington is 981·19, a number probably correct to within 3 parts in 100,000. An uncertainty of this amount in g introduces a possible error of 1½ parts in 100,000 in the value of the ampere, and, as all other probable errors are smaller in magnitude, it is important that a more accurate determination of g be made.

To realise the volt with an accuracy approaching that of the ampere, as now known, it is necessary that an absolute determination of resistance of corresponding precision be undertaken. Through the kindness of the Drapers' Company, of London, it is hoped that such a determination by means of a Lorenz apparatus may be completed at the National Physical Laboratory before the end of next year. At the present time the uncertainty in the absolute value of the international ohm approximates to 4 in 10,000.

From the above value of $C \times B$ for the cadmium cell together with the ratio of Clark to cadmium, viz.,

$$\frac{\text{Clark at 15° C.}}{\text{Cadmium at 17° C.}} = 1{\cdot}406_5,$$

the E.M.F. of the Clark cell at 15° C. becomes $1{\cdot}432_0$.

The Committee recognise very fully the skill and devotion of Mr. Mather and Mr. Smith, on whom the work of carrying out the experiments has fallen, and have invited these gentlemen to become members of the Committee.

Papers by Mr. F. E. Smith, of the National Physical Laboratory, dealing with the use of the silver voltameter and the preparation of the Weston cadmium cell, are nearly ready for publication.

Some preliminary work has also been done on the design for the Lorenz apparatus, the funds for which are being found by the Drapers' Company. The proposed design embodies new features of importance.

With regard to the proposed Conference on Electric Units further consideration led to the conclusion that a year's delay was desirable, and in consequence the meeting was postponed from October, 1906, to October, 1907. With a view to a preliminary agreement on the matters to be raised, correspondence has passed during the year between the secretary, acting as director of the National Physical Laboratory, and the heads of Standardising Laboratories in other countries. The Conference will probably deal with the drawing up of an International Convention relative to electric units, which should include the draft of a form of law which might be adopted generally in the various countries represented, and the consideration of the steps necessary to secure uniformity in the carrying out of the laws in different countries, and to arrange for determinations necessary for this purpose.

The necessary invitations for the Conference are being issued by His Majesty's Government.

To secure uniformity in carrying out the law, it will be necessary that specifications for constructing and using a mercury unit of resistance, for setting up and working a silver voltameter, and for preparing a standard cell, be approved either by the Conference itself or by some body nominated by the Conference for this purpose.

With a view to aiding discussion, very detailed specifications dealing with the voltameter and the cell have been prepared by the National Physical Laboratory and issued to other Standardising Institutions. These are printed in Appendices II and III.

It is not suggested that the final specifications need be so full or so detailed, but it was thought well that all information necessary to assist in criticising the results should be included.

The work on the silver voltameter and Weston cell still continues, and, in view of the deliberations of the Conference, it is probable that further expenditure will be required. The accounts show that a balance of 10s. 8d. remains from the grant of £50 made last year. The grant has been spent on the purchase of material and appliances for the research.

In view of the importance of bringing the work of redetermining the values of the fundamental units to a satisfactory conclusion, the Committee recommend that they be reappointed, with a grant of £50, and with the addition of the names of Mr. A. P. Trotter, Mr. T. Mather, F.R.S., and Mr. F. E. Smith; that Lord Rayleigh be chairman and Dr. Glazebrook secretary.

APPENDIX I.

Notes on the Present Condition of the Work on Electric Units at the National Physical Laboratory. By F. E. Smith.

(From the National Physical Laboratory.)

1. *The Ohm.*—(*a*) *Absolute Unit.*—The value of a resistance in absolute measure is still subject to considerable uncertainty; the most satisfactory value is obtained from the mean observed ratio of the international ohm to the absolute ohm.*

A provisional design has been prepared for the Lorenz apparatus which the Drapers' Company are kindly presenting to the National Physical Laboratory, and experiments to test the more important features of the design are in progress. It is hoped to realise the ohm in absolute measure to 1 part in 100,000. The experience gained in the construction of many of the fittings of the ampere balance will greatly facilitate the work.

(*b*) *International Unit.*—Further comparisons of some of the mercury standards of the National Physical Laboratory were made in October and November, 1906. There appears to have been no change in any of the tubes which affects the resistance of the contained mercury columns by as much as 1 part in 100,000. The following table gives the observed differences in 1903 (the year of their construction) and in October and November, 1906.

Mercury standards compared.	Observed difference in Int. ohms in 1903.	Observed difference in Int. ohms in 1906.
M — P	$0{\cdot}00069_4$	$0{\cdot}00068_5$
M — T	88_8	89_2
M — U	94_7	95_3
M — V	$-\ 29_8$	$-\ 30_1$
M — X	01_8	02_3

2. *The Ampere.* (*a*) *Absolute Measure.*—When the ampere balance was designed, it was hoped by means of it to measure a current in absolute value to 1 part in 10,000, but it will be seen from the report on the balance that the evaluation of a current of nominal value 1 ampere is subject to an error which appears to be not greater than 1 part in 50,000.

(*b*) *International Unit of Current.*—The International Conference on Electric Units at Charlottenburg (1905) re-affirmed the definition of the International ampere in terms of the deposit of silver in a silver voltameter or coulometer, but expressed the opinion that the information before it was insufficient to enable it to propose any alteration in the formerly accepted value for the ampere, or to lay down exact directions in respect to the silver voltameter.

The Rayleigh type of voltameter has been used in a large number of investigations, but the researches of Rodger and Watson, Richards, Kahle, and others have shown that this voltameter, as generally employed, gives results which may vary as much as 1 part in 1,000.

In the research at the National Physical Laboratory a reproducible type of voltameter was sought, but after making a large number of observations on various forms it was found that, subject to certain easily attained conditions, all the forms give identical results to 1 part in 100,000. As the Rayleigh type is the simplest to erect and produces the least variation in the current strength, it is proposed that this form be specified. The conclusions arrived at in the research differ appreciably from those of most other observers, and attempts have been made to experimentally reproduce the conditions under which they worked. In part we have been successful, but there are still anomalous results for which we can at present offer no explanation.

It is certain, however, though the complete chemistry of the silver voltameter or coulometer is unknown, that a reproducible type can be specified, and that the International ampere can be defined in terms of the deposit of silver with very great accuracy, certainly to 1 part in 100,000.

The Standard Cell.—For the past five years experiments have been made at the National Physical Laboratory on Clark and on Weston cadmium cells, and two years ago a provisional specification of the cadmium cell was published. It is gratifying to know that the specification proved of value, for in 1906 51 cadmium cells were submitted for test at the National Physical Laboratory, and all of these were prepared on the lines of the specification. The cells were intended for commercial use, and they were packed with small crystals of cadmium sulphate to be more portable; also we have reason to believe that in some cases the mercurous sulphate had not been properly washed, and in other cases the solution of cadmium sulphate was slightly acid. Nevertheless the E.M.F. of these cells agreed with the N.P.L. cells to about 2 parts in 10,000, the N.P.L. cells having the lower voltage. Standards more carefully set up have been submitted by two observers for comparison with the N.P.L. cells in accordance with the offer made in the "British Association Report," 1905. The cells prepared by one of these observers—Mr. Tinsley, of Beckenham—differed from the N.P.L. cells by about 0·1 millivolt, or 1 part in 10,000. Mr. Mather also submitted a number of cells, and these had approximately the same mean E.M.F. as those from Mr. Tinsley. The N.P.L. cells were the lower in voltage, and freshly prepared cells agree with old ones.*

In May, 1907, twelve Weston cadmium cells set up by Dr. Wolff at the National Bureau of Standards, Washington, were compared with a number of the cells of the National Physical Laboratory, and a mean difference of 3 parts in 1,000,000 was measured. Dr. Wolff's cells were, we believe, set up quite independently of the N.P.L. specification, which makes this remarkable agreement all the more gratifying.

APPENDIX II.

Specification for the Practical Application of the Definition of the International Ampere.

(From the National Physical Laboratory.)

In the following specification the term silver voltameter (or coulometer) means the arrangement of apparatus by means of which an electric current is passed through a solution of silver nitrate in water. The silver voltameter measures the total electrical quantity which has passed during the time of the experiment, and by noting this time the time average of the current, or, if the current has been kept constant, the current itself, can be deduced.

In employing the silver voltameter to measure currents of about 1 ampere the following arrangements should be adopted:—The cathode on which the silver is to be deposited should take the form of a patinum bowl about 10 centimetres in diameter and 7 centimetres in depth. The mass of the bowl is conveniently about 80 grams.

The anode should be a plate or disk of pure silver coated with a deposit of electrolytic silver, the mass of the latter being about 50 per cent. greater than the mass of silver to be deposited on the cathode. The plate or disk of silver should be of about 6 centimetres edge (or diameter) and 3 or 4 millimetres in thickness. Its total area will thus approximate to 60 square centimetres. The anode should be supported horizontally in the liquid near the top of the solution by a silver rod riveted through its centre. To prevent the disintegrated silver which is formed on the anode from falling upon the cathode the anode should be inserted into a cup of filter paper separately supported.

The liquid should consist of a neutral solution of pure silver nitrate, containing about 15 parts by weight of the nitrate to 85 parts of water.

The resistance of the voltameter changes somewhat as the current passes. To prevent these changes having too great an effect on the current some resistance besides that of the voltameter should be inserted in the circuit. If the value of the current is desired and the measurement is one of high precision, this external resistance should be from 50 to 100 ohms; in other cases the resistance should not be less than 10 ohms.

Method of making a Measurement.

1. *The Solution.*—The silver nitrate should be purchased as pure and recrystallised twice; the recrystallisation is preferably done by evaporating a saturated solution in a flask over a water bath. The

* See table in the *British Association Report* for 1892.

* In Mr. Mather's cells electrolytic mercurous sulphate was used; in Mr. Tinsley's cells the mercurous sulphate was prepared by the chemical precipitation method.

mother liquor should be drained away and the crystals dissolved in pure freshly distilled water. Prolonged contact of the crystals or of the solution with impure air must be avoided. The solution should be neutral to sensitive litmus paper.

If the silver nitrate is recovered from much used or contaminated solutions, or from an acid solution, the recovered salt should be fused (preferably in an electric oven) and afterwards dissolved, and the solution filtered before the recrystallisation processes; otherwise it may be necessary to recrystallise more than twice.

During electrolysis in the voltameter herein specified the silver nitrate solution does not change in composition *as a result of the electrolysis* by an amount which is detectable by any tried means, but, owing to the presence of impurities in the atmosphere, the solution should not be used more than once if great accuracy is desired.

2. *The Anode.*—The anode should be prepared by cleaning the silver plate or disk with sandpaper or a scratch-brush. It should be washed with distilled water and supported so as to form the *cathode* of a silver voltameter. The anode of this latter should be a silver bowl or a platinum bowl coated with silver, and the liquid should be a 15 per cent. solution of silver nitrate in water; this solution need not be specially pure. If the anode bowl is of platinum coated with silver and of the dimensions already specified, it is convenient to employ about 350 cubic centimetres of the solution and support the silver plate or disk horizontally in the liquid near the top of the solution. A convenient current for depositing silver on the plate is 0·3 ampere. The plate is washed with distilled water and dried in an electric oven.

The cup of filter paper should be about 5 centimetres deep and of a diameter a little greater than that of the silver plate. It is made by folding a large filter paper (such as Schleicher & Schull No. 595, 24 cm. diameter) over a glass cylinder (such as a bottle) of appropriate diameter and securing the upper portions of the folds of the paper with sealing wax or with platinum wire. The cylinder is removed and that portion of the paper which is above the seals is cut away. The upper parts of the internal folds are also secured with sealing wax or with platinum wire.

3. *The Cathode.*—The platinum bowl should be cleaned with a strong solution of sodium hydrate, followed by washings with water, strong nitric acid and distilled water. It is then made the *anode* of a silver voltameter, the liquid being a 15 per cent. solution of silver nitrate (an impure solution serves) having a volume of about 350 cubic centimetres. The cathode should be a clean silver plate supported near the top of the solution. With a current of about 1 ampere the circuit should be completed for 10 minutes at least, after which the cathode and liquid are removed from the bowl. The bowl is washed with water and afterwards cleaned with strong nitric acid; washings with distilled water, strong nitric acid, and distilled water follow in the order named, and the bowl is dried in an electric oven at a temperature of about 160° C. It is removed to a desiccator and when thoroughly cool it is weighed. A bowl of similar size and of approximately the same mass is convenient as a counterpoise.

4. *The Circuit.*—The platinum bowl is placed in position in the intended circuit and 300 cubic centimetres of the solution of silver nitrate are placed in it. The anode is placed inside the filter paper cup and the latter suspended by platinum wires which are insulated from the anode and from the rest of the circuit. The anode and filter paper cup are supported so that the silver plate or disk is covered by the solution; the connections to the remainder of the circuit are then made. Contact is made at a key and the time noted. The current is allowed to pass for an interval depending on the precision desired, and the time of breaking contact must be observed. For measurements of high precision from 7 to 10 grammes of silver should be deposited. During the passage of the current the voltameter should be covered over, to exclude light.

5. *Deposit of Silver.*—The solution is removed from the bowl and the deposit rinsed with about 100 cubic centimetres of distilled water. The washing water is poured into a clean glass crystallising dish and the operation of washing is repeated three times. The bowl is then nearly filled with distilled water and left for at least three hours; it is rinsed three times, the last of these washing waters remaining in the bowl for 10 minutes. This should give no milkiness when added to a neutral solution of sodium chloride in water. The bowl is dried in an electric oven at a temperature of about 160° C.

If any loose silver is observed in the solution outside of the filter paper cup, or in the washing waters, these liquids must be filtered, the filter paper dried, and the loose silver added to the bowl before drying the deposit. The bowl is cooled in a desiccator and weighed again. The gain in mass gives the silver deposited.

6. *Calculation.*—To find the current in amperes this mass, expressed in grammes, must be divided by the number of seconds during which the current has been passed and by 0·001118. The result will be the time average of the current, if during the interval the current has varied.

In determining the constant of an instrument by this method the current should be kept as uniform as possible, and the readings of the instrument observed at frequent intervals of time. These observations give a curve from which the reading corresponding to the mean current (time average of the current) can be found. The current, as calculated from the voltameter results, corresponds to this reading.

Notes on Observations.—If this specification is carefully followed the mass of silver deposited for the passage of one coulomb through the voltameter is constant within the limits of the errors of measurements of the highest precision. It is certainly constant to one part in one hundred thousand.

The specification is possibly too rigorous for many practical needs, and for such a simplification is possible. The solution of silver nitrate may be prepared from purchased silver nitrate, provided it is free from acid. The anode may be a plate of pure silver without electrolytic silver deposited thereon. The remainder of the specification must be followed.

Effect of Pressure.—The observations may be made at any ordinary atmospheric pressure, or exceptionally low pressures, as the mass of silver deposited when the silver voltameter is under a pressure of 76 centimetres of mercury is the same as when under any lower pressure to 2 centimetres of mercury, and possibly without these limits.

Effect of Temperature.—This specification is based on observations at or about a temperature of 17° C. Observations at other temperatures have been made and are being continued; if there is a temperature coefficient to the silver voltameter it is exceedingly small.

This specification is based on the results of a large number of measurements made at the National Physical Laboratory.

APPENDIX III.

Preparation of the Weston (Cadmium) Standard Cell.

(From the National Physical Laboratory.)

Definition of the Cell.—The cell has mercury for its positive electrode and an amalgam of cadmium, consisting of 12½ parts by weight of cadmium to 87½ parts of mercury, for its negative electrode. The electrolyte consists of a saturated solution of cadmium sulphate, and solid cadmium sulphate is contained within the cell. A paste consisting of solid mercurous sulphate, mercury and cadmium sulphate rests on the positive electrode.

Preparation of the Materials.

1. *Mercury.*—Commercially pure mercury should be squeezed through wash leather and passed in the finely divided condition in which it emerges through dilute nitric acid (one part of acid to six parts of water) and mercurous nitrate solution, and afterwards through distilled water. These liquids are conveniently contained in long glass tubes. The mercury is then distilled twice in vacuo. Mercury suspected of any abnormal contamination should not be employed.

2. *Cadmium Amalgam.*—A current is passed from a thick rod of pure commercial cadmium to distilled mercury, the intervening liquid being cadmium sulphate solution rendered slightly acid with a few drops of sulphuric acid. The cathode is weighed before electrolysis commences, and again afterwards; the percentage of cadmium in the amalgam is then calculated. More than the requisite amount of cadmium should be deposited and the percentage reduced to 12½ by the addition of mercury. To prevent the anode slime having access to the cathode the anode should be contained in a filter paper cup, as in the Rayleigh form of silver voltameter. Contact with the cathode is made by a platinum wire sealed into a glass tube, the wire being thus protected from direct contact with the cadmium sulphate solution. An approximate estimate of the quantity of cadmium deposited is obtained from the readings of an ammeter placed in the circuit. The amalgam, with very dilute sulphuric acid flooding its surface, is melted over a water bath and stirred to ensure homogeneity. It is then ready for use.

3. *Cadmium Sulphate.*—Procure commercially pure cadmium sulphate, $CdSO_4 . 8/3\ H_2O$. Powder in a mortar and dissolve in distilled water until a saturated solution results: filter the solution through a fine-grained filter paper until it is quite clear. The liquid should then be placed in a large crystallising dish and slowly evaporated at a temperature of about 35° C., when, provided that dust is excluded, many transparent crystals of $CdSO_4 . 8/3\ H_2O$ will result. In this way about five-sixths of the solution may be evaporated (the mother liquor may be used for a preliminary washing of the mercurous sulphate, the manufacture of which is described hereafter). The recrystallised cadmium sulphate should be washed with successive small quantities of distilled water, until after standing for 10 minutes no trace of acidity can be detected in it with sensitive congo-red paper: the crystals, still moist, are transferred to a stock bottle. To prepare the saturated solution the crystals are crushed in a mortar and agitated with distilled water. The latter may be warmed to 35° C.

4. *Mercurous Sulphate.*—Add 15 cubic centimetres of pure strong nitric acid to 100 grams of pure mercury contained in a crystallising dish, and place on one side until the action is over, or nearly over. Transfer the mercurous nitrate thus formed, together with the excess of mercury, to a beaker containing about 200 cubic centimetres of dilute nitric acid (1 of acid to 40 of water by volume); a clear solution should result. Prepare about 1 litre of dilute sulphuric acid (1 of acid to 3 of water by volume), and while the mixture is hot add the acid mercurous nitrate solution to it. The solution should be added as a *very* fine stream from the narrow orifice of a pipette and the mixture violently agitated during the mixing. Mercurous sulphate is precipitated and rapidly settles to the bottom of the vessel when the stirring ceases. Decant the hot clear liquid and wash the precipitate twice by decantation with dilute sulphuric acid (1 of acid to 6 of water by volume). The precipitate should then be filtered. (A small Buchener filter funnel and a filter flask is very convenient for this latter operation.) Wash the precipitate three times with the dilute sulphuric acid (1 to 6), and afterwards wash six or seven times with saturated cadmium sulphate solution to remove the acid. After each washing the liquid should be removed as completely as possible by the filter pump. When these operations are complete the mercurous sulphate is flooded with saturated cadmium sulphate solution and

left for one hour; the solution is then tested with congo-red paper. In general no acid will be detected, and the mercurous sulphate is ready for use. It is placed in a stock bottle together with some saturated cadmium sulphate solution, and should be kept in the dark. If acid is detected the washing must be continued. When the cells are required for observations of the highest precision the apparently neutral mercurous sulphate should not be immediately used. It is placed in a bottle with saturated cadmium sulphate solution, and at the end of one week the latter is tested for acidity. The sulphate is given another washing with the solution, and may then be used if only a trace of acid is detected.

One of the following methods of preparation may, if desired, be substituted for the foregoing:—

1. *Electrolytic Method.*—This preparation is conducted in a darkened room. Pure distilled mercury forms the anode and platinum foil the cathode, the electrolyte being dilute sulphuric acid (1 volume of acid to 5 volumes of water). The mercury is placed in the bottom of a large flat-based beaker and about 20 times its volume of the dilute acid is added. Contact with the mercury is made by a platinum wire passing through a glass tube, and the cathode is suspended in the upper portion of the liquid. During electrolysis the electrolyte must be continually stirred, an L-shaped glass stirrer being very efficient, the foot of the L moving close to the surface of the mercury. A convenient current density is 0·01 ampere per square centimetre of anode surface. The mercurous sulphate so prepared is filtered and the greater part of the mercury removed; it is then washed with dilute sulphuric acid and saturated cadmium sulphate solution in a manner already described for the previous preparation.

2. *By Means of Fuming Sulphuric Acid.*—Place distilled mercury in a crystallising dish so as to just cover the bottom. Add sufficient fuming sulphuric acid to flood the surface of the mercury to a depth of about 2 millimetres. Cover with a clock glass and place on one side for 48 hours. Mercurous sulphate is formed and appears in the crystalline form. Carefully add the salt to hot dilute sulphuric acid (1 to 6) and well agitate. Decant the hot liquid. If any caked masses of the sulphate are left these should be rejected or crushed in an agate mortar. Wash three times by decantation with hot dilute sulphuric acid, and afterwards filter and wash with saturated cadmium sulphate solution in the manner already described. Set aside with cadmium sulphate solution for one week at least, test for acidity, and wash as described for the first preparation.

The Mercurous Sulphate Paste.—The mercurous sulphate is mixed with about one-fourth its volume of powdered recrystallised cadmium sulphate, and about one-tenth its volume of pure mercury. (When the electrolytic sulphate is used, or that prepared with fuming sulphuric acid, no mercury need be added.) To the mixture of mercurous sulphate, cadmium sulphate, and mercury sufficient saturated cadmium sulphate solution is added, so that when well mixed the whole forms a thin paste.

Setting up the Cell.—The type of H-form of cell which may be hermetically sealed is the most convenient; if the lower end of each limb is slightly constricted the contents of the cell are less liable to be disturbed. The platinum wires inside the glass vessel are amalgamated by passing an electric current from a platinum wire anode through an acid solution of mercurous nitrate to each of the wires in turn as a cathode. The vessel is washed out twice with dilute nitric acid, several times with water, and finally with distilled water; it is dried in an oven. A small pipette is used for the introduction of the amalgam, and a small thistle funnel for the insertion of the paste and crystals. The main stock of amalgam is flooded with very dilute sulphuric acid, and it is melted over a water bath; a little of it is introduced into one of the limbs of the H-vessel. After the amalgam has solidified this limb must be washed out several times with distilled water, care being taken to avoid wetting the interior of the other limb. A little distilled water is added and the amalgam is melted by immersing the limbs of the H-vessel in hot water. After the solidification of the amalgam it is washed once more with distilled water. Into the other limb sufficient mercury is introduced to cover the amalgamated platinum wire; then the paste is added, care being taken not to smear the sides of the vessel. Finally, powdered crystals of cadmium sulphate are introduced into each limb, and saturated cadmium sulphate solution is added. The cell may be immediately sealed with the aid of a blowpipe, but the contents must not be abnormally heated thereby. The cadmium amalgam introduced should cover the amalgamated platinum wire; the depth of the paste should be from 0·5 cm. to 1·0 cm., and the depth of the layer of crystals about 0·5 cm. 24 hours after the cell has been set up it may be used. Its electromotive force at 15° C. is $1{\cdot}018_5$ volt. The electromotive force at any other temperature may be obtained from the formula given by the Phys. Techn. Reichsanstalt, viz.,

$$E_t = E_{20} - 0{\cdot}000038\,(t-20) - 0{\cdot}00000065\,(t-20)^2,$$

or from the formula obtained at the National Physical Laboratory,

$$E_t = E_{17} - 0{\cdot}000034_5\,(t-17) - 0{\cdot}00000066\,(t-17)^2.$$

This specification is based on observations made at the National Physical Laboratory.

The Old Order Changeth.—The chairman of the Leyland and Birmingham Rubber Co., Ltd., told his shareholders on 9th inst. that the disposable balance was £1,310 less than last year, chiefly owing to the breakdown of the main engine, which took six months to repair, the works meanwhile running under extremely adverse conditions. The breakdown cost the company at least £10,000, but the directors were switching on electricity wherever possible in order to prevent a similar loss in future.

LEGAL.

Marylebone's Electricity Charges.

The recent action in which the Marylebone Borough Council was successful in four test cases brought against residents of Hampstead, who had been transferred to Marylebone for local government and electric lighting purposes without their consent, and who had, in consequence, refused to pay what, to them, was a higher rate for their electrical energy, was referred to at the Marylebone County Court on Thursday last week.

Mr. Edward Abinger, counsel briefed by the defendants, said that owing to the fact that his clients were unrepresented at the hearing of the case in July, his Honour might possibly not have been put in possession of all the facts of the case. A great many Hampstead residents had been transferred with the four defendants in the action, and his Honour's decision was in consequence of very great importance.

Mr. Pemberton, of Messrs. Pemberton & Clark, auctioneer and estate agent, of Abbey Road, St. John's Wood, one of the defendants, had, for instance, a contract with the Hampstead Borough Council by which he was to be supplied with electricity at the rate of 4d. a unit for ten years, but suddenly, without any proper notification, he was transferred to Marylebone, where he had to pay 8d. a unit, or just double. It was questionable whether an Act of Parliament could put an end to a contract in that way, when no notice had been given.

His Honour reminded Mr. Abinger that the London Electric Lighting Areas Act in this case not only gave to the Marylebone Borough Council the same powers over the residents in the transferred areas as it had over the other residents in the borough, but relieved the Hampstead Borough Council of its duties and obligations.

Counsel added that the Marylebone Borough Council did not charge all their consumers 8d. a unit, but some only 6d. They seemed to get whatever they could, and the whole management of the affair seemed to be in a chaotic state. He asked the judge to grant him leave to serve the other side so that all the facts of the case might be laid before his Honour.

Judge Selfe said he felt he was in full possession of the facts of the case. He had expressed sympathy with the defendants because he considered the decision he was forced to come to was very hard upon them. He was ready to give the defendants every facility, and because of the hardness of their case had granted leave to appeal, but if counsel considered that all the facts had not been put before the Court, he was ready to consider an application for a new hearing.

Mr. Abinger obtained permission to reconsider his position.

PARLIAMENTARY.

London County Council General Powers Bill.

This Bill was before Lord Dartry's Select Committee of the House of Lords the whole of last week.

Mr. Fitzgerald, for the Council, explained that part 9 of the Bill provided for an extension of time for the completion of works sanctioned under the Improvements Act of 1900. Included in those improvements was the extension of the Thames Embankment to Lambeth Bridge, but delay had arisen in the negotiations with the Westminster Electric Supply Co., to whom the Council were under an obligation to reinstate their works and generating station on an equivalent site to that which was required for the improvement. The Commissioner of Works had addressed a letter to the Committee pointing out the danger which would arise to the Houses of Parliament and the Tate Gallery and their contents from chemical exhalations from the proposed station of the electric company. A clause had been inserted by the House of Commons Committee giving the Commissioner powers of inspection and compelling the company to provide for smoke consumption and to take precautions to prevent the evolution of oxides of sulphur. So as to protect the company, the Council had agreed to insert a clause by which they were to reimburse the company of any expense incurred in carrying out the Board of Works recommendations. The Electric Co. were opposing the extension of time. Under an agreement made in 1900 the Council undertook not to use any portions of the company's site until two years after the transfer of an equivalent site which the Council were to provide, and to erect a station and install therein plant capable of producing the same amount of current as at the date of transfer.

Mr. Moon, K.C., for the Westminster Electric Supply Corporation, said that in 1905 when they expected the transfer to take place the capacity of his clients' station was 4,000 kw., but in 1909, the year the Council proposed to extend the time of transfer to, the capacity would have developed to 7,000 kw., and they contended that the period of two years was not sufficient.

The Committee allowed a period of 2½ years from November 1st next in which to effect the transfer.

Glasgow Corporation Bill.—In their report to the House of Commons on the Glasgow Corporation Bill, Mr. Corrie Grant's Committee present the following special report on the Bill:—"The Bill, as submitted, contained provisions for borrowing £50,000 for tramway purposes and £50,000 for a storm-water overflow in connection with the main drainage system of Glasgow. The necessity for these works was satisfactorily proved before your Committee, but it is their established practice to require the production of precise and detailed estimates of expenditure when a loan is asked for. In the case of the Glasgow Corporation an estimate of the proposed expenditure on tramway extensions was laid before the Committee amounting to £41,862, but no satisfactory explanation was given in evidence of the difference between the borrowing powers of £50 000 asked for and the estimated cost of the proposed works. . . . Your Committee are of opinion that great carelessness was displayed in the presentation of the case, and that the promoters did not appreciate the necessity of accurate detailed estimates. Your Committee, though obliged to condemn the conduct of the Bill, have not felt justified in declaring the preamble not proved; but they have limited the borrowing powers to the exact sums proved by estimates. The case disclosed the fact that the general orders made under the Private Legislation Procedure (Scotland) Act do not require detailed estimates to be submitted in every case, and your Committee are unanimously of opinion that in this respect those orders require amendment."

Third Reading.—In the House of Commons on August 12th the Oxford and District Tramways Bill was read a third time.

Tramway Accidents.—In the House of Commons on the 8th inst., the President of the Board of Trade was asked what was the position of the inquiry into the question of a satisfactory tramcar brake. Mr. Lloyd-George, in reply, said that his attention had been called to accidents of this character, and inquiries had been ordered in two cases that occurred within the last week. He added, according to the *Times*, that apart from the attention which the Board's inspecting officers are necessarily giving to the subject, the whole question of braking appliances on tramways is being investigated by committees of the Tramways and Light Railways Association and the Municipal Tramways Association. The Board are prepared to assist these committees in a combined investigation at a later stage.

BUSINESS NOTES.

Electrical Promotions in Japan.—According to the German Consul at Nagasaki, the company-promoting fever has manifested itself to a much greater extent in the northern and central portions of Japan than in the district of Kiushiu. In the administrative region of Kukuoka, which is situated in the centre of economic activity in the south, 16 companies have been formed, with a nominal capital of £4,500,000, and have applied to the authorities for concessions to authorise the construction of electric railways. Several electric tramways and connections with motor-omnibuses are also projected in the administrative district of Nagasaki. The Consul states that with few exceptions the companies represent still-born undertakings, especially as a reaction has taken place in the zeal for new companies, and a sceptical view of such concerns is being taken. Of the proposed lines a concession had been granted at the beginning of May for the construction of an electric tramway from Moji, *vid* Kokura and Yawata to Kurosaki. The light railways in the Kumamoto district—from Kumamoto to Ozu and from Kumamoto to Suizenji—were in process of building when the Consul forwarded his communication, and both are expected to be opened for traffic before the beginning of October in the present year.

The World's Rubber Production.—The *Financial Times* says that according to Hecht's statistics, which have just been issued for the year ended June 30th, 1907, the production of rubber throughout the world amounted to 74,023 tons, as compared with 67,999 tons in the preceding harvest year. The world's consumption is stated to have been 68,173 tons, as against 62,574 tons in 1905-6, and the stocks existing on June 30th, 1907, are put at 6,464 tons, as contrasted with 5,352 tons at the corresponding period of 1906. The arrivals of all qualities of rubber in Europe, which are included in the foregoing totals, reached 36,547 tons in the past year, as compared with 37,486 tons in 1905-6, and the arrivals in the United States were 32,730 tons, as against 25,596 tons respectively. These figures show remarkable progress for the latter country simultaneously with a decline in the shipments received in Europe. The past two years represent an unmistakable downward movement in the prices of fine Para, which received the highest rate of 5s. 8½d. per lb. in the year 1904-5. The quotation for the 1905-6 harvest opened at 5s. 7d. and closed at 5s. 1⅝d. In July, 1906, the rate of 5s. 0½d. was touched, but a perceptible recovery took place, and in January, 1907, the price attained 5s. 2⅝d. Since then a retrogression has taken place, the lowest point being reached at 4s. 6⅝d. in June, although the harvest year terminated with a slight advance to 4s. 7½d. per lb.

A Madrid Exhibit.—The Fredk. Crane Chemical Co., of 22 and 23, Newhall Hill, Birmingham, last month dispatched a collection of their goods for display at the Madrid International Exhibition which is to open on September 1st, and to remain open until the end of November. Before dispatch the goods were exhibited on the firm's premises at Birmingham. The object of the exhibit is to show a selection of goods coated with the firm's various lacquers. They secured the co-operation of seven or eight customers who supplied a selection of their goods coated with these lacquers, and in most cases this lacquering was done on their own premises, and not specially by the Crane Chemical Co. for exhibition purposes. The articles will illustrate particularly their gold dye process by which large quantities can be cheaply and effectively lacquered and gilt, and which is particularly applicable to cheap electro-brassed articles. We understand that it brings up the electro-brassing to a rich colour which it is impossible to obtain with any other process of lacquering. This particular process is applicable to, and used largely for, high class work, the articles shown of this grade, including such things as highly finished electric table stands and brackets. They are also showing, mounted on a board, a full set of their coloured and frosted electric lamps. With the firm's lacquers the clear glass can be made any colour or frosted. The exhibit further includes illustrations of their spray process. This is a highly decorative process which is already being largely used. The effects obtained are capable of infinite variations according to the taste and feeling of the operator. The lacquers are sprayed on to the metal through the Aerograph spraying machine. We understand that since the Spanish-American war Spain has awakened very considerably to the necessity of cultivating various branches of trade, and some considerable quantities of goods upon which lacquers are used are now being manufactured there. The company have issued a list in Spanish using Spanish measures and weights, so that the Spanish inquirer will have a clear knowledge of the uses of the goods and the prices at his own measures.

Austrian Siemens-Schuckert.—A further step in connection with the consolidation of the electrical engineering industry in Austria is proposed to be taken by the transfer to the Austrian Siemens-Schuckert Works Co. of the Leopoldau cable factory belonging to the Siemens & Halske Co., of Berlin. The former has had an option of this particular undertaking for some time past, and it is now intended to exercise it with the co-operation of the Austrian Lander Bank, the Bohemian Union Bank and the Vienna Bank Verein. It has been mutually arranged between these financial institutions to take over an issue by the Siemens-Schuckert Co. of a 4½ per cent. loan of the nominal value of £333,000, which sum will be devoted to the purchase of the before-mentioned cable factory, and also serve the purpose of reducing the floating liabilities.

Electric Cranes for Cape Town.—At the last meeting of the Table Bay Harbour Board, the engineer called attention to the necessity that existed for an electric travelling crane at the graving dock. A new 15-ton crane would probably cost about £3,000, but the existing crane could be made to answer present requirements at a cost for staging, &c., of £450. The matter was referred to the Finance Committee.

Ideas Wanted.—A firm of outfitters require something novel and attractive in the shape of a pediment or superstructure, and are anxious to receive suggestions from our readers. The pediment is to fit a shop front of about 18 ft., and must cost under £30. It is, presumably, to possess electrical features.

A Carbide Factory in Yorkshire.—We are informed that the British Carbide Factories, Ltd., of 11, Queen Victoria Street, E.C., have commenced the construction of the first large carbide of calcium factory in England at Thornhill, Yorkshire. This factory is more or less an experimental undertaking, and is believed to be the first attempt on a large scale to utilise the surplus output of a large power station (in this case that of the Yorkshire Electric Power Co.); or in other words, to fill up the valleys in the load charts of the station, this being the only means of securing, in this country, energy at a price low enough to enable the competition of Continental waterfalls to be met. This initial factory will be equipped, to commence with, with plant for about 2,500 B.H.P., and will, we are informed, be run on a new system patented by Mr. Charles Bingham, which will enable the power station to supply the carbide factory with any amount of energy desired, varying between a minimum of 250 KW. and the maximum capacity of the furnaces. During the two hours of peak load, the power station will be enabled practically to cut off the supply to the carbide factory entirely, if desired, while the arrangements permit of the load being varied from minute to minute, as desired by the Power Co. The factory is expected to commence working in about four months.

Flame Lamps for Works Lighting.—The British Thomson-Houston Co., Ltd., have received an order from Messrs. Aveling & Porter, Rochester, for 95 of their new flame arc lamps for illuminating their works. The lamps are to have special compensators, each controlling two lamps and arranged with middle terminal, so that single lamps may be switched on and off.

Book Notices.—*The Wire Tappers.* By A. Stringer. London: T. W. Laurie. Price 6s.—This is a novel. It is not often that we have to criticise a work of fiction in these pages, and, in fact, our only excuse for doing so is that this deals with a subject of electrical interest. It describes the adventures of a man and woman, over whom the glamour of romance is cast to cloak the fact that they are thieves or pirates, their avocation being that of professional tappers of telegraph and telephone lines. By means of the secret information thus obtained, they are enabled to carry out various schemes with the aim of acquiring pelf, which, however, is generally stolen from them in the hour of triumph. Viewed from the technical standpoint, there is a good deal about relays, Morse alphabets, rheostats, &c., which indicates that the author has taken the trouble to acquire some information about the subject, though the air of familiarity assumed by him is somewhat overdone. As a novel, the story is frequently far-fetched, but undoubtedly interesting, and at times even exciting; there is plenty of incident, but no very coherent plot. We can recommend it as being better than the average novel.

"The Art of Cutting Metals." By Frederick W. Taylor, M.E., Sc.D., which was the Presidential address presented at the last annual meeting of the American Society of Mechanical Engineers, has been reprinted and bound in cloth by the Society. Price $3. This or any other publication of the society may be had by addressing the secretary, 29, West 39th Street, New York. It is not necessary to send orders through members. None of the publications of the American Society of Mechanical Engineers are copyrighted. The address in question has become a standard work, and will shortly be in its third edition.

"The Mechanical Design and Construction of Commutators." By R. Livingstone. Price 6s. net. "Brakes for Tramway Cars." By H. M. Sayers, M.I.E.E. Price 3s. 6d. net. "The Electric Furnace in Iron and Steel Production." By J. B. C. Kershaw, F.I.C. Price 3s. 6d. net. "Handy Copper Wire Tables and Formulæ." By P. B. Down, Wh.Ex. Price 2s. 6d. net. London: The *Electrician* Printing and Publishing Co., Ltd. 1907.

"Journal of the Institution of Electrical Engineers," Vol. 39, No. 185. August, 1907. Contents: "Depreciation," by Robt. Hammond; "The Use of Wooden Poles for Overhead Power Transmission," by C. Wade; "Recent Improvements in Electric Lighting," introduced by A. H. Bate; "Central Station Supply Economics," by A. M. Taylor; "Some New Fly-Wheel Storage Systems," by A. P. Wood; "The Experimental Determination of the Losses in Motors," by C. F. Smith; "Technical Training of Electrical Artisans," by C. P. C. Cummins; and "A New Leading-In Conductor for Electric Lamps," by C. O. Bastian. London: E. & F. N. Spon. 5s.

"Herzogliche Technische Hochschule zu Braunschweig." Programme for the Session 1907-8, commencing October 15th. Brunswick: F. Vieweg und Sohn. 1907.

"The Univeral Directory of Railway Officials, 1907." By S. Richardson Blundstone. London: The Directory Publishing Co., Ltd., 3, Ludgate Circus Buildings, E.C. Price 10s.

We have received from the offices of the Agricultural and Horticultural Association a copy of a penny pamphlet written by the Hon. H. A. Stanhope, entitled "Weather"—a subject of supreme interest to gardeners and holiday-makers.

Catalogues and Lists. — SIMPLEX CONDUITS, LTD., Birmingham.—Complete edition of their catalogue combining their Red, Blue and Grey lists that were issued in November, 1906. In the course of some 60 pages well illustrated descriptions of their conduits and accessories appear. The arrangement of the illustrations has received a special care at the hands of the compilers, prices being placed alongside the blocks wherever practicable, for easy reference. We understand (we have not counted them) that altogether some 3,500 prices are quoted in the list. We need not enumerate all the special lines that are included in the list, for the user will find an ample alphabetical, and also a numerical, index. There are some pictures in the front of the book which are intended to represent views inside the works—the latter, it will be remembered, were fully described in our pages last year. One of the company's latest new features is the Simplex pin contact system. It will be evident that in steel conduit wiring mechanical and electrical continuity of the runs, for the purpose of efficient earthing, is necessary owing to the higher voltages now in use. To meet these requirements the company introduced, in 1904, their grip continuity system, whereby it became practicable by means of a contact nipple and the use of screwed fittings to erect a socket joint conduit system with perfect continuity and capable of efficient earthing. The company now claim that by their new pin contact device socket joint conduits may be erected electrically and mechanically continuous at practically no increase in cost over an ordinary socket-joint installation. A particular advantage in connection with this system, is that existing installations can be made continuous at a very slight cost. Simplex pin contact is effected thus: a small slot is left in the lip of all socket fittings, and when the enamelled tubing is socketed home in the ordinary way, a small hardened metal pin or dowel is inserted and hammered sharply home. This pin cuts its way into the fitting and into the skin of the tube, and being under great pressure makes efficient and lasting contact without the necessity of scraping or injuring the enamel in any way; the projecting part of the pin may subsequently be filed off flush.

UNION ELECTRIC CO., LTD., London, S.E.—This company is just issuing a bound catalogue (90 odd pages) covering a large range of high tension apparatus. It is well printed, and contains a number of illustrations, including various diagrams. The main sections include both oil-break and horn-type high-tension switches, lightning arresters and discharging gaps. The catalogue is a completion and enlargement of the high-tension list No. VII published by the company about two years ago. Illustrated descriptions are given of many forms of construction. Amongst the important novelties are the cellular combined automatic release switchboards, the Alma interlocked cellular switchboards, the remote control solenoid action switchgear, the individual iron-clad cellular panels, the Vogelsang automatic paralleling apparatus, and the automatic release device operated by high-tension current. Engineers interested in high-tension dynamic electricity can have copies of the catalogue on application to the company. The copies are all numbered, and will be recorded on the company's card file, so that supplementary sheets may be posted to the recipients from time to time.

THE ELECTRICAL CO., LTD., has issued a leaflet (No. 244) giving prices and particulars of "Sunshine" flame arc lamps.

THE CYCLONE GRINDING WHEEL CO., London, E.C.—Circular relating to "Cyclone" "B.B." grinding wheels, giving instructions to users, also a list of prices.

MESSRS. HUDSON & BOWRING, LTD., Manchester.—New pamphlet giving diagrammatic and other interesting illustrations showing the action of their "H.B." tramcar lifeguards, of which we learn that over 10,000 are now in use. The firm is very busy at present with orders for Belfast, Dublin, Caracas, Shanghai, Rhondda Valley, Accrington, and 250 sets of guards for the L.C.C.

UNION ELECTRIC CO., LTD, Southwark, S.E.—List relating to the Kohinoor arc lamp, for which, in response to a demand for a shadowless lighting arrangement for interior work, the firm have introduced a new cover and outfit (No. 152). This they claim to give shadowless illumination which renders it particularly suitable for banks, offices, private rooms, &c.

MESSRS. MAVOR & COULSON, LTD., Glasgow.—Illustrated inquiry form relating to their electric haulage gear.

A.E.G. ENGLISH MANUFACTURING CO., LTD., London.—Leaflet, with diagrams, relating to Nernst burners and polarity.

Fire Alarms.—MESSRS. MANN, EGERTON & CO., LTD., of Norwich, have received an order from the May-Oatway Fire Appliances, Ltd., for the wiring of Messrs. J. and J. Colman's premises, Norwich, for their fire alarm system, consisting of about 1,000 detectors.

Trade Announcements.—The SOCIETE GRAMME have given up their London offices at Gray's Inn Road, and have transferred the whole of their business for Great Britain and the Colonies to Thomas L. Scott & Co., Ltd., of 28, Martin's Lane, Cannon Street, E.C. They will continue to make a speciality of combined petrol electric sets, alternating current generators and motors, electro-plating dynamos, &c.

MESSRS. J. E. SPAGNOLETTI & CO. announce that with a view to facilitate the further development of their business the firm has been registered as a private limited company. The name in future will be Spagnoletti, Ltd. The directors will be Mr. J. E. Spagnoletti, Mr. H. M. Bayly, Mr. J. Lawrence, and Mr. J. Lothian Nicholson, all of whom have been long associated with the management of the business. The firm manufacture all classes of high and low tension switchboards and switchgear, meters, accessories, telegraph and railway signal instruments, and any new designs of electrical apparatus.

Turbine Contracts.—We reported last week that the Brussels Municipality had recently placed an order for a 5,000-KW. turbine of the Zoelly type against international competition. We are informed that in the case of the city of Amsterdam the result was different, as in this case the order for the two 4,000-KW. turbo-alternators required was placed with Messrs. Brown, Boveri and Co., the well-known makers of the Parsons turbine on the Continent. The tendering for this particular job was very keen, and was interesting because of the fact that not only did the makers of the Zoelly and other impulse type turbines make a strong bid for the work, but one of the most important makers of the Parsons turbine in England also competed.

German Electrical Industry.—The Council of Defence for the Electrical Industries of Germany, reporting on progress in 1906, observes that there are now 100,000 skilled electricians employed at the various works in Germany, as against 82,000 in 1905, and the aggregate capital of the limited liability companies engaged in electrical undertakings was increased from £31,250,000 in 1905 to £35,500,000 in 1906. During 1906 Germany applied 151,000 tons of copper to electrical purposes, the average London price for the metal being £110 15s. per ton, as against £85 16s. in 1905.—*Com. Intell.*

Stoker Contracts.—A large number of contracts recently booked by MESSRS. E. BENNIS & CO., LTD., include the following:—For the Rochdale Corporation Electricity Works (per Messrs. Yates & Thom, Ltd., boiler makers, Blackburn):—Two stokers and self-cleaning compressed air furnaces for Lancs. boiler. This is an extension to eight Bennis stokers and furnaces already working there. For Messrs. Greenwood & Batley, Ltd., engineers, Leeds:—One double stoker, and self-cleaning compressed air furnaces for an 8 ft. 6 in. diameter Lancs. boiler.

Bankruptcy Proceedings.—FRANCIS WILLIAMS, electrician, Bemerton, Salisbury.—A first and final dividend of 3d. in the £ is payable on August 13th. Official Receiver, City Chambers, Catherine Street, Salisbury.

Liquidation.—ROSSENDALE BELTING CO., LTD.—A petition presented by J. Briggs & Co., Ltd., for winding-up this company, is to be heard at Manchester on August 19th.

Surface Condensers.—Messrs. Willans & Robinson, Ltd., of Rugby, have acquired the rights for the use of the "Contraflo" type of surface condenser, in addition to the "Vacuum Augmenter" system, which owes its introduction to the Hon. C. A. Parsons. Messrs. Willans & Robinson, Ltd., have during the past year or so obtained orders for over fifty complete sets of their ordinary type of surface condenser, and it is believed that the "Contraflo" and "Vacuum Augmenter" systems will enable them further to extend this branch of their manufactures.

LIGHTING and POWER NOTES.

Aberdeen.—At last week's T.C. meeting the Electricity Committee recommended that with the view of preventing explosions, the engineer be authorised to replace the existing copper strip culverts by cables on the solid system, and that the Union Street system should be commenced as soon as arrangements can be made. The estimated cost of the work is about £9,000. Mr. Todd said trouble of a similar kind had occurred from this cause in other cities; and, as several methods had been proposed for obviating explosions, he moved that the matter be remitted to the Committee to obtain outside expert opinion. Bailie Kemp said the Committee in their recommendation were following the example of other cities which had had to deal with precisely the same thing, and there was no remedy known other than that recommended to them by the engineer. The recommendation was adopted.

Ashford (Kent).—The B. of T. recently wrote to the U.D.C. stating that the Ashford and District Electric Supply Co., Ltd., had failed to comply with the requirements of the Board, who were of opinion that the order should be revoked. The Council has decided to take no action in the matter.

Bangor.—The T.C. has applied to the L.G.B. for loans of £400 for meters, and £600 for mains and services.

Beckenham.—At the last Council meeting Mr. Neville moved—"That a Special Committee of the Council be appointed to inquire into and report at the earliest possible moment upon the accounts, present condition and management of the electricity undertaking, with full power to investigate into all matters connected therewith." In the result 5 voted for the motion and 11 against.

Billingham.—At the request of the P.C. the R.D.C. has appointed a committee to consider the advisability of lighting the parish by electricity instead of by oil lamps as at present.

Bovey Tracey.—Last week a public meeting passed a resolution in favour of a scheme for the electric lighting of Bovey Tracey. A company is about to lay down a large plant to supply power to the Haytor Iron Mines, so that the one plant would supply both purposes. It was stated that Mr. Raleigh Phillpotts, the lessee of the Bovey Tracey Lignite Mines, had had experiments carried out in France with lignite. The power plant would be laid down at the lignite pit, and transmitted to a station somewhere in the town.

Bradford.—Mr. T. Roles, Corporation electrical engineer, has submitted to the Electricity Committee an exhaustive report regarding the supply of electricity for power purposes and the rates of charging for the supply. It is urged that two important reasons render it necessary that the subject should receive serious consideration without delay. First, the output of electricity supplied for power purposes has remained practically stationary since 1904; secondly, that several applications have recently been received from firms in the city for large power supplies at lower rates than at present obtain in connection with the department. The sale of electricity during the present financial year is not increasing to anything like the extent which could be expected or desired, and the falling off in consumption exactly coincides with the increased charges which came into vogue as a result of a resolution passed by the Electricity Committee on July 3rd, 1903, the charges coming into operation during the half-year ended June 30th, 1904. Up to and including the year ended March 31st, 1904, the average horse-power of the motors connected gradually rose from 3·5 to 5·1, but since that date it has gradually dropped to 4·8. This result has undoubtedly been effected by the larger consumers giving up taking a supply from the mains and installing their own generating plants or adopting gas engines, operated for the most part by suction gas. The average horse-power of the motors connected yearly since the revision of the tariff has shown no tendency to rise, indicating that, as a rule, only small motors are now being coupled up. The number of units sold annually per horse-power of motors connected also showed an almost uniform tendency to rise up to the period at which the alteration was made in the charges, but since then the units sold per horse-power have dropped, thus proving that the majority of consumers being retained belong to the short-hour class. The charges between the years 1899 and 1904, during which period the consumption increased substantially each year, were 1d. per unit for the continuous users, and 2d. per unit for intermittent users. Practically all users were regarded as continuous, excepting those who required the energy for operating cranes and hoists. Since the price has been raised none have been able to obtain energy at a lower rate than 1½d. per unit, which has caused them to look for and obtain a cheaper source of power. Mr. Roles shows that the long-hour consumers are being overcharged to a very considerable extent, and a certain proportion of the revenue derived by this overcharge is absorbed in making up for losses on account of consumers who have an average consumption of 'ess than 1½ hours per day. This fact gives a sufficient explanation of the reason why short-hour consumers continue to be attracted and retained, whereas the long-hour consumers are dissatisfied, and are adopting other sources of power. In recommending a new tariff, or rather an extension of the present tariff, to meet up-to-date requirements, the engineer has endeavoured to provide rates which will meet the needs of both the long-hour consumer and the consumer with the heavy demand for power. In the first place, he recommends that for consumers with a total maximum demand not exceeding 10 kw. the existing rates be adhered to, with the exception that the price be reduced from the maximum rate of 2d. per unit in somewhat smaller steps than at present to a minimum of 1d. per unit instead of 1½d., which later is the lowest rate charged under the present tariff. The rates of charging for large power users which the engineer suggests for adoption are from ¾d. to 2d. per unit. The engineer is of opinion that until a revision of charges is made to motive power consumers, no headway will be made by the department in the direction of increased output, as the gain from the few small consumers which are from time to time being coupled up under the existing rates will be more than counterbalanced by the large consumers which will be lost if matters are allowed to remain where they are. The Yorkshire Power Co. are gradually extending their operations on the eastern boundary.

Bray.—The E.L. Committee, after taking counsel's opinion on the question of selling the electric light concern, reports that it cannot recommend the board to proceed any further with the project.

Burnley.—The Electricity Committee has recommended the T.C. to carry out extensions to the electricity works and plant at an estimated cost of £10,000. The plant itself includes two Lancashire boilers, economisers, and coal-handling plant.

Cheltenham.—At a recent meeting of the Electricity Committee letters were read from the L.G.B. stating that they had found it necessary to reconsider the periods allowed for repayment of loans, and that the period granted for the loan of £6,825 was an equated one based on the periods now generally fixed by the board for similar works, and they could not undertake to extend it. They were, however, willing to allow the sum of £1,689, being the unexpended balance of the £17,200 loan, to be applied towards the cost of the works instead of towards the cost of the Hatherley Outfall Sewer, and would issue amended sanctions and consent accordingly. The borough electrical engineer reported that the coal bonus scheme was working satisfactorily, and that a saving in coal of the value of £11 17s. 2d. had been effected for the four weeks ending July 8th, which, after deducting bonus of £1 16s. 7d., left a net saving of £10 0s. 7d. At present the bonus was divided between the men on evening shifts only. He thought a further saving could be made by increasing the bonus and dividing the extra amount between the day and night shifts, and he recommended that the present bonus of 2s. 6d. for each cwt. per 1,000 units be increased to 5s., the extra 2s. 6d. being equally divided between the day and night shifts in the same proportions as at present. The recommendation was approved.

Chichester.—It was announced at a meeting of the T.C. on Friday that the E.L. Co. had paid the £500 due for the transfer of the E.L. Order, and that the deed of transfer had been approved of by the B. of T.

Cobham.—The Woking Electric Supply Co. have informed the Epsom R.D.C. that they intend applying to the B. of T. for a prov. order for E.L. at Cobham.

Colne.—The T.C. has decided to lay out £5,500 on further developing the electric plant.

Continental Notes.—Italy.—The authorities of the province of Bergamo have granted a concession to Messrs. Festi and Rasini to put down a plant to utilise the water power of the River Serio at Cardesio, in the generation of electrical energy for power purposes in a cotton mill at that place.

Darwen.—The annual financial statement shows a surplus of £96 on the electric lighting account; a surplus of £478 on the Darwen section of the electric tramways; and a deficiency of £594 on the Hoddlesden section. The number of units sold during the year was 660,812, compared with 656,918 for 1906. Lighting claimed 148,955 units, an increase of 7,527 on 1906; power, motors, and radiators, 61,419, an increase of 10,239; public lamps, 58,570, a decrease of 2,878; and traction 391,868, a decrease of 9,994.

Derby.—At the T.C. meeting on 7th inst., Alderman A. Butterworth, in presenting the report of the E.L. Committee, stated that they had had to pay a considerable amount more for coal than they did last year, and this would entail an increased expenditure of about £1,000 for the year. This increase would prevent any reduction being made in the price of electricity.

Devonport.—According to the *Western Morning News* the success of the E.L. installation in the Naval Ordnance Depôts and Magazines at Bullpoint, Devonport, has resulted in the War Department approving of estimates for completing similar work in connection with the property there under military control. The buildings consist of a range of magazines for the storage of cordite and powder cartridges, shell, and miscellaneous stores. The contract for completing the electric light installation has been given to Messrs. Foote & Milne, of Westminster, and the work of excavating the trenches for the electric cables has commenced. The installation will include lighting pillars and chambers at intervals to feed the watertight incandescent lamps to be used for illuminating the passages of the magazines, and the arc lights which are to be fixed on steel standards near the entrances and at positions along the line of transporting rails and landing jetties. It is expected that the work will be completed during the current financial year.

Dundee.—At the last meeting of the Electricity Committee, Mr. Richardson intimated that unless the orders for the most important plant were placed in the course of a month's time, there would be very little chance of getting the new generating station running even for the winter of 1908-9, owing to manufacturers' deliveries. In order to push on with the erection as quickly as possible, it was decided to ask for tenders for the foundations in the Hennebique system of reinforced concrete, on the understanding that tenders be accepted only from contractors who are qualified by experience to carry out such work. At the same time the engineer was instructed to ask for tenders for the high and low-tension cable systems in order that the contracts therefor be placed as early as possible.

Dunfermline.—After two years of consideration, the T.C. has failed to come to any satisfactory conclusion of the electric lighting question. Repeated discussions have taken place, a prov. order was secured, and expert opinion obtained to guide the Council, but the finding of a special meeting last week was to endeavour to influence the Fife Electric Power Co. to take over the order at cost.

Dunrobin Castle.—The Duke of Sutherland has recently installed the electric light at Dunrobin Castle.

Eastbourne.—The total income of the electric light department, after deducting allowances and bad debts, reached £22,405, against which was an expenditure of £10,102, leaving a gross profit of £12,303, which was £1,210 more than the previous year. The net profit totalled £1,568, or an increase of £266. This profit had been carried to the profit appropriation account, which had already to its credit £7,926 brought forward from the previous year. Various sums have been charged to this account, reducing the balance to £7,365.

Erdington.—A L.G.B. inquiry was held on August 8th into the application of the Aston Manor T.C. for a loan of £17,519 for electricity purposes at Erdington, and a further loan of £1,650 for cable extensions to large works. It was explained that Aston had obtained a prov. order for electric light at Erdington, and that as the result of a canvass 104 residents had expressed willingness to take current as soon as it was available. There was no opposition.

Farnworth.—Messrs. Eli Dyson, Ltd., cotton spinners, of the Piggott Street Victoria Mills, have just made arrangements with the local District Council for a supply of current.

Govan.—The annual report of the T.C. electricity department states that during the year 2,327,036 units were generated. Of these 1,899,465 units were sold, 245,214 being consumed at electricity works, 467,543 for stair and street lighting; 487,165 for private lighting, and 944,757 for power purposes. The total revenue was £14,009, and the working costs £13,462, showing a surplus of £547. This was an increase of 18·5 per cent. over the previous year in units sold. The increase was accounted for by additional power demand. The only decrease was that of 2 per cent. in the lighting, and this was attributable to the closing of shops under the Early Closing Act. Although coal was 20 per cent. higher than in the previous year, the price per unit had been reduced by 9·4 per cent.

Gloucester.—The engineer's annual statement concerning the electricity supply department was before last week's City Council meeting. The number of consumers has increased from 503 to 535, and the lamps from 41,344 to 47,735. The total revenue was £11,238 and the expenditure £6,548. Interest charges absorbed £3,200 and loan repayment charges £2,331. The net result has been a loss of £841 for the year, owing to an additional expenditure of £909 on loans. There was increased expenditure owing to cost of coal, materials, &c.

Haddington.—The Electric Works and Development Co., Ltd., has given notice of its intention to apply for a prov. order.

Hanley.—The T.C. has decided to reduce the price of current as from July 1st, for lighting from 6d. for 91 hours per quarter to 6d. for 73 hours. Long-hour consumers will be supplied after the first three hours per day at 2d. per unit.

Harwich.—Messrs. Foote & Milne, Ltd., have informed the T.C. that they intend applying to the B. of T. for a prov. order.

Hartlepool.—At a meeting of the T.C. on 7th inst., a proposed agreement between the Corporation, the Northern Counties Electricity Supply Co., Ltd., and the Cleveland and Durham County Electric Power Co., was considered. The agreement provided for the taking over by the latter company of the powers held by the Corporation under its prov. order, and at present leased to the Northern Counties Co., which supplies the electric lighting of the borough. Ald. Horsley moved that the agreement be sealed. Councillor Watson, as an amendment, moved that the T.C. allow the Cleveland Power Co. only until the expiration of the three years which had yet to run under the old arrangement; at the end of that period the Council could consider the advisability of extending the period. After lengthy discussion the amendment was carried by 11 votes against 7.

The T.C. met in committee on 12th inst., when the proposed agreement was further considered. It was resolved to add a clause relieving the Corporation of any obligation to take light from the Cleveland and Durham County Power Co. after March, 1911, when the present agreement with the Northern Counties Electricity Supply Co. expires.

Hornsey.—The T.C. is applying to the L.G.B. *re* a loan of £10,000 for extension of mains and services.

Electricity is to be substituted for gas at the Highgate depôt of the T.C., the fire stations and firemen's dwellings, and the clock tower at Crouch End, at a cost of £211.

London.—MARYLEBONE.—At a recent B.C. meeting the Electric Supply Committee presented the annual statement of accounts for the year ending March 31st, the first complete year of the Council's operation as a supply authority. The total capital expenditure amounted to £1,905,005, of which £134,005 was in respect of that year. The expenditure on capital account during the current year would probably not exceed £30,000. The gross revenue from consumers amounted to £155,594, and the total income amounted to £158,460. Of this, working expenses, management, &c., absorbed £49,818, other special expenses bringing this total up to £52,728. The costs per unit sold averaged 1·45d., as compared with 1·622d. in 1906, an improvement of about 10 per cent. on the estimate. The management costs were still unduly high, but they hoped that during the next 12 months they would be lessened. The average price charged for current was 4·7d. per unit (including meter rental), showing a reduction of 9 per cent. The total sales showed a substantial advance, and progress was also being made with a view of securing an increased use of the supply for power purposes. There was a balance of £105,732 to meet capital charges. Interest on and expenses of obtaining loans, provision for bad debts, &c., amounted to £73,091, and after providing £10,579 for redemption of loans and reduction of capital indebtedness, there remained a net balance of £22,062 on the year's working. But for the heavy burden of interest, the margin would have been much larger, and in addition to the balance there was £6,672 set aside for redemption of debt, over and above the instalments falling due and paid within the year. With £7,299 brought forward last year, the balance available for depreciation and renewals was £29,360. The Committee recommended that from the credit balance at March 31st, 1907, viz., £29,360, a sum of £7,000 be set aside for a special contingency fund, and that the balance, viz., £22,360, be placed to a reserve fund for the renewal of plant and replacement of obsolete units, as recommended by Messrs. Price, Waterhouse & Co.

Oulton Broad.—The U.D.C. on Friday decided to apply for a prov. order for E.L. Similar applications are being made by the local electricity company and Lowestoft T.C.

Portrush.—The Urban Council on the 8th inst. had before it the amended specifications of Mr. John Woodside, A.M.I.C.E., Belfast, for the lighting of the town. The full discussion of the scheme was adjourned till the September meeting.

Radcliffe.—Owing to the large and increasing number of users of electricity in Radcliffe, an extension of the public generating works has become necessary, and the U.D.C. has decided to apply to the L.G.B. for permission to spend £13,000 on additional plant.

Scunthorpe.—The U.D.C. has appointed a committee to consider what steps shall be taken with reference to the E.L. order, which expires at the end of the year.

South Shields.—The T.C. on the 7th inst. adopted a recommendation by the Electrical Committee that the existing charges for energy for power purposes be abolished, and that the following reduced charges be substituted:—1½d. per unit for the first 5,000 units per quarter, and 1d. per unit for all afterwards per quarter, less 2½ per cent. discount.

Stalybridge.—A loan of £3,908 for electricity purposes has been applied for by the Stalybridge, Hyde, Mossley and Dukinfield Tramways and Electricity Board.

Thornhill.—The Electricity Distribution of Yorkshire, Ltd., having informed the U.D.C. that they intend applying for a prov. order for electric lighting, the Council has decided to apply for its own order.

Warrington.—The R.D.C. on August 8th discussed the proposal of Warrington T.C. to apply for a prov. order for E.L. The Burtonwood P.C. asked the Council to oppose the application, and it was decided to oppose "any attempt to get a general order giving the T.C. the monopoly for the supply of electricity in the district."

The T.C. has decided to apply for a loan of £3,070 for extensions at the electricity station.

Wednesbury.—The electricity department is to proceed with various extensions of the cables to enable the new system of supply to be introduced when the proper time arrived. Tenders are to be accepted for erecting a new station and for new machinery. The building to be erected is to be sufficient to provide for the extensions which it is hoped will become necessary in the immediate future.

Wigan.—At the meeting of the T.C. on August 8th, Alderman Ashton moved that in future the management of the Electric Light and Tramways Department be delegated to two separate committees. Councillor Taylor (vice-chairman of the committee) intimated that he declined to serve on either committee. He then walked out of the chamber. The two new committees were then appointed, and the following resolution was agreed to:—"That the Local Government Board or the Board of Trade be requested to hold a local inquiry into the working and financial position of the Wigan electric light and tramways from their inception."

TRAMWAY and RAILWAY NOTES.

Aberdeen.—The tramway accounts for the past year are as follows:—Revenue £72,605 (increase £2,098); working expenses, £40,434 (decrease £250). £13,422 has been placed to the credit of renewal fund, the largest sum that the committee has, so far, been able to put to it.

Blackburn-Accrington. — Arrangements have now been completed for the inter-running of electric cars between Blackburn and Accrington. The electrical energy is supplied by Accrington, which collects the fares and meets Blackburn by paying fourpence for every mile covered.

Bradford.—Lieut.-Col. E. Druitt, R.E., held a Board of Trade inquiry at Bradford on August 6th, into the tramway accident which occurred on the previous Wednesday. The inquiry was private.

Burnley.—Electric tramways are now being utilised as royal mail coaches. The Postmaster-General, at his request, has been furnished with a quotation for the conveyance of mails on the cars between Padiham and Burnley and Brierfield and Burnley, the figure named being at the rate of £35 per annum—the mails to be placed on and removed from the cars at the termini by the postal officials.

Continental Notes. — GERMANY.—The question of utilising the water-power available in Bavaria will again be brought before the Diet for consideration on the forthcoming re-assembly. It is calculated that no less than 700,000 H.P. can be obtained from Bavarian waterways, the most important being the Alz, the Walshensee and the Lech, and it is suggested that 200,000 H.P. should be reserved to the State for the working of the southern railways. According, however, to a memorial which has been prepared for the information of the Diet by the Ministry for Railways, a reservation of only 92,000 H.P. is now proposed for the electrical working of railways. The memorial submits that the remunerativeness of electric railway operation appears to have been established, and it is foreshadowed that by the adoption of this method of locomotion an annual economy of £350,000 would be realised in the working of the southern railways in Bavaria. If the Diet should decide in favour of the introduction of electric traction on these lines when the memorial is discussed in the autumn, the Government will proceed with the preparation of definite plans for the establishment of hydro-electric works. In the meantime the proposal of the Baden Aniline and Soda Works Co., which contemplates the erection of works for the extraction of nitrogen from the atmosphere, remains in abeyance owing to the difficulties of making arrangements for the acquisition of water-power for the purpose. The Siemens Co. is now also credited with the promotion of a scheme having a similar object in view in connection with the utilisation of the water-power of the Alz.

AUSTRIA-HUNGARY.—The American Consul at Prague, in a recent report on the electric lines of Bohemia, states that the official returns just published show the following results regarding the traffic and receipts of the electric street railways of Bohemia for the year 1906:—

	No. of passengers.	Receipts.
Prague	27,895,289	$724,364
Prague-Luben	1,742,543	53,207
Aussig	2,411,539	46,905
Gablonz	1,741,580	83,656
Marienbad	1,351,673	14,715
Pilsen	1,085,942	28,767
Reichenberg	2,615,988	67,694
Teplitz Eichwald	1,696,081	47,259

In Prague the passengers carried during the year 1906 showed an increase of nearly 4,000,000 persons as compared with 1905.

Darwen.—It is reported that a writ has been issued against the Darwen Corporation by a firm of tramcar manufacturers, who allege that their patents are being infringed in the regenerating apparatus used by the local Corporation. Application "to restrain" has been made to the High Court, but the Council has entered appearance. At present three of this class of demi-car are used on the Darwen tramways. They have proved very popular with the inhabitants.

Llandudno-Colwyn Bay.—On Friday last trial trips were run between Penrhyn Hill and Rhos-on-Sea. The cars ran satisfactorily, but it is stated that the B. of T. will not grant the necessary certificate to carry passengers until the cars are provided with hand-brakes in addition to the Westinghouse brakes.

London.—L.C.C.—In view of the danger resulting from the employment of men as drivers who are physically unfit for their work, the Council has called upon all the drivers to undergo medical examination.

Manchester.—Since April 1st the electric tramway takings have amounted to no less a sum than £281,000, or an increase of £21,000 over the same period (four and a-half months) of last year.

Musselburgh.—It appears that there is no prospect of a friendly termination to the strike of tramway men, which began on the 1st inst.; Mr. Hunter, the manager, recently stated that after the conduct in which they had indulged, the strikers would not be reinstated on any terms. Several members of the Corporation sided with the men, and endeavoured to remove the police protection from the depôt and the six cars which were kept running. The drivers were stoned on several occasions.

The company has refused to go to arbitration. Several men have been arrested for obstruction, and convicted.

N.E. Railway.—According to a Newcastle newspaper, the electrification of the South Shields and Sunderland to Newcastle section of the North-Eastern Railway is now definitely under consideration. The engineers will inspect the route and prepare their report at an early date, and the decision of the company will be known in November.

In the course of his speech to the half-yearly meeting of this company, the Right Hon. John Lloyd Wharton, in referring to the electrical sections, said that with regard to electric train working, to which he had alluded at previous meetings, the account was satisfactory. The cost of electric train working showed a slight increase, due to their having run a larger number of trains and car-miles, but the receipts showed a more than corresponding increase, and the takings had now got back to nearly what they were five years ago, when their competitors—the electric trams—began to run. That was a very satisfactory result.

Salford.—Mr. G. W. Holford, general manager of the Corporation tramways, has just presented his annual report, in which it is shown that the work of this department continues to grow. There were nearly two million more passengers carried in the year ending March last than in 1905-6, the total being 43,614,123. The receipts amounted to £231,908, as compared with £223,032. The net profit amounted to £27,889, which represents an advance of £5,587. The amount contributed in reduction of rates remained the same as in the two preceding years—£13,000; but the unusually large sum of £14,889 was transferred to the depreciation and renewals fund. The year 1906-7 was the first period in which no fatalities occurred in connection with the tramways. Two persons were killed in the preceding year, and it is interesting to note that this is at the rate of only one in every 20,900,000 passengers carried. There are now 177 cars in use.

Southampton.—The total receipts of the Corporation tramways for the past year amounted to £51,004, and the total expenses, including interest £6,434, and sinking fund £5,192, to £50,842, leaving a balance of £162. New capital expended during the year amounted to £1,151. The car-miles run were 1,143,085, and 9,437,396 passengers were carried.

South Lancashire.—The Farnworth U.D.C. has given permission to the South Lancashire Tramways Co. to make a junction between their line in Egerton Street, Moses Gate, and the terminus in Bolton Road, Moses Gate. A deputation of the U.D.C. has been appointed to see Mr. Salter, manager of the South Lancashire Tramways Co., re the line of tramway to Little Hulton. The company's powers to construct tramways to Little Hulton will lapse in a few weeks, unless exercised.

South Shields.—At a meeting of the T.C. on the 7th inst. several reports were submitted as to extensions of the Corporation's tramways system. The borough surveyor estimated the cost of construction of permanent way and track, &c., of an extension along Bertram Street to a terminus near Corstorphine Town at £2,590, while an extension from Eddon Street to Green Street was put down at £8,980. For special engineering work £1,875 was put down, and the electrical engineer estimated the cost of the electrical equipment for the whole extension at £2,300, and for the Bertram Street section at £600.—The report was referred to a Sub-Committee.

(Continued on page 288.)

THE ELECTRIFICATION OF THE HAMMERSMITH AND CITY SECTION OF THE GREAT WESTERN RAILWAY.

(*Concluded from page* 228.)

The Royal Oak sub-station is equipped with four 400-KW. traction motor-converter sets, worked in parallel with a battery having a one-hour discharge rate of 1,680 amperes, in conjunction with reversible boosters. The sub-station also contains two 200-KW. motor-converters for D.C. lighting and power purposes.

The Shepherd's Bush sub-station, as shown in the accompanying illustrations, is equipped with seven 400-KW. traction motor-converters worked in parallel with a battery having a one-hour discharge rate of 840 amperes, in conjunction with reversible boosters.

The Old Oak Common sub-station is equipped with one 400-KW. and two 200-KW. motor-converter sets for D.C. lighting and power purposes.

From each of the three sub-stations H.T. feeders are run to the various distributing centres. All three sub-stations are designed so that they may be developed on the same lines.

The Royal Oak sub-station, which is typical of the others,

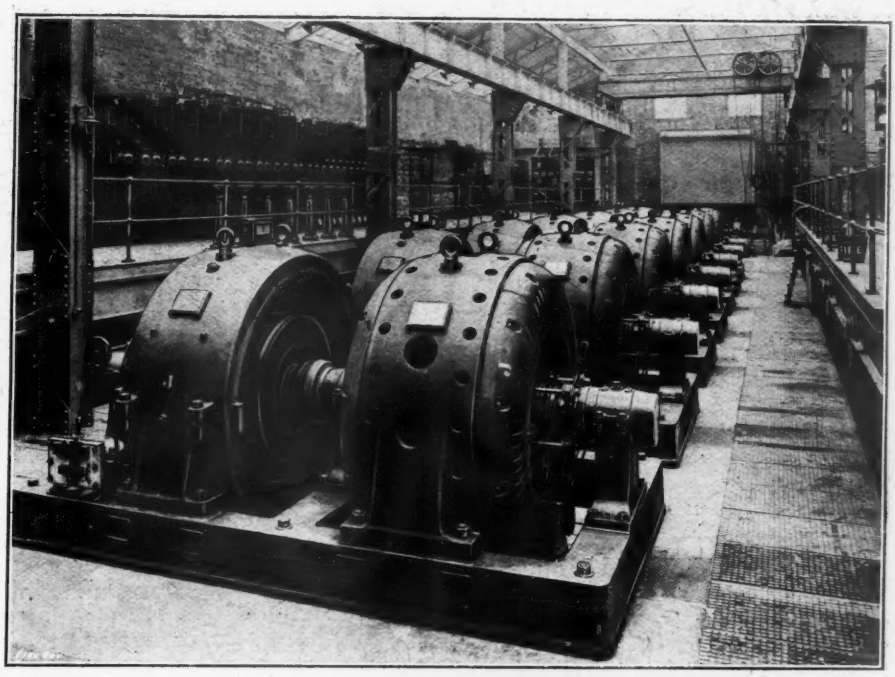


FIG. 17.—SHEPHERD'S BUSH SUB-STATION; L.T. SWITCHGEAR TO THE LEFT.

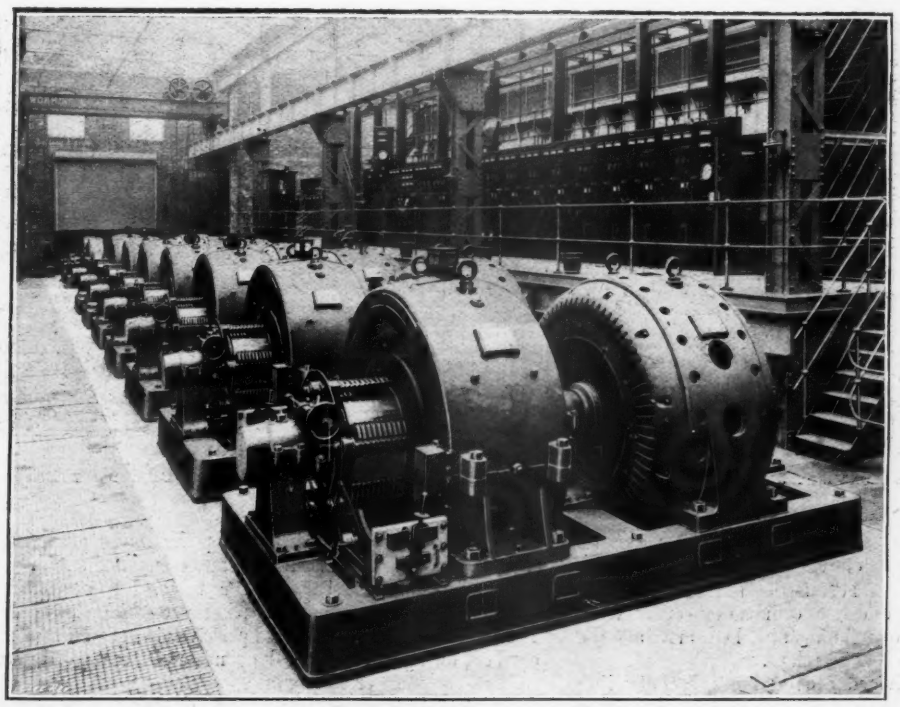


FIG. 18.—SHEPHERD'S BUSH SUB-STATION; PEEBLES MOTOR-CONVERTERS, H.T. SWITCHGEAR, &C.

is built in three bays; the motor-converters and reversible boosters are placed in the centre bay, over which a 10-ton hand-worked travelling crane is provided, and the side bays house the H. and L.T. switchgear. At one end of the H.T. switchboard a transformer room is provided, which forms one of the distributing centres, and is equipped with static transformers for supplying A.C. at 220 volts for local lighting, including the lighting of the sub-station. Next to the transformer room a workshop is provided, and adjoining is the battery room.

The reversible boosters, of the well-known Highfield type, are in duplicate, the continuous capacity of each being 130 KW. (fig. 19). The battery consists of 290 of the Tudor Co.'s cells (fig. 25, p. 266).

The H.T. switchgear is generally similar in construction and design to the Park Royal H.T. switchboards, which have been described previously. The incoming H.T. feeders are connected to the centre of the board, the traction motor converters being connected to the one end, and the lighting converters and the H.T. distributors to the distributing centres, to the other end. The H.T. distributors and the lighting motor-converters are connected to an extension of the upper set of main bus-bars. The latter can be divided into two sections, and are arranged so that either can be shut down without cutting off the supply from any distributing centre. The main H.T. feeder switches are provided with time-limit overload and instantaneous reverse current relays, the H.T. distributor switches, and all the H.T. motor switches with overload relays.

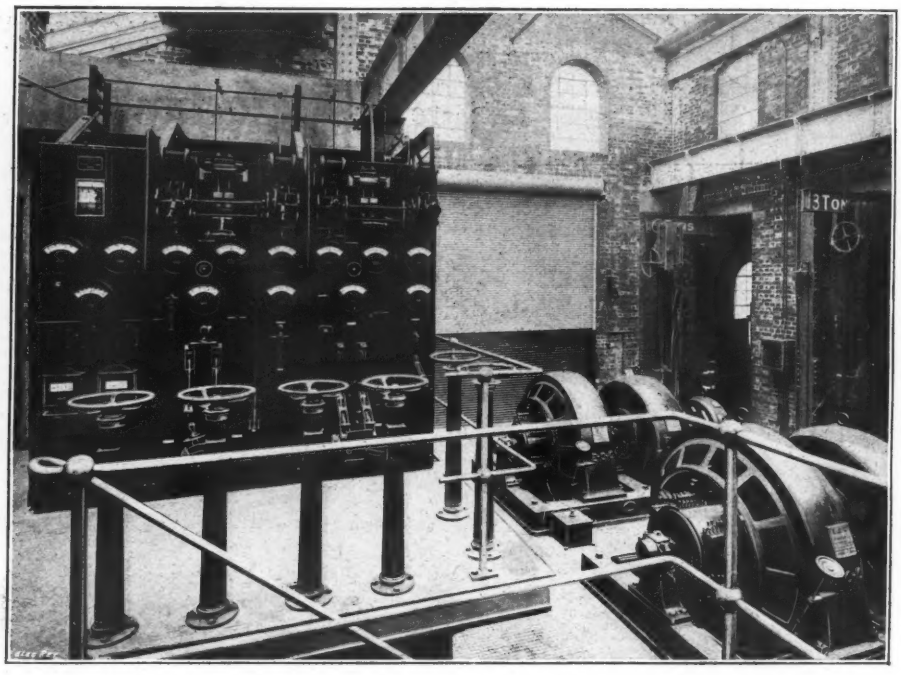


FIG. 19.—SHEPHERD'S BUSH SUB-STATION; HIGHFIELD REVERSIBLE BOOSTER AND BOOSTER SWITCHBOARD.

The L.T. switchgear is divided into four sections, controlling respectively the traction circuits, lighting circuits, a milking booster and its connections to the battery room, and the Highfield reversible boosters. The L.T. machine and feeder connections are of bare copper rod, supported by porcelain insulators.

The motor-converters are normally started up from the H.T. side, but the 400-KW. traction motor-converters can also be started up from the D.C. side from the battery. The D.C. machines are connected to the bus-bars through reverse current circuit breakers.

A feature of special interest is the method of using the battery not only to equalise the load on the motor-converters, and therefore on the main H.T. generators, by taking the peaks of the traction load, but also, in cases of emergency, for maintaining both the alternating and direct-current lighting supply. The arrangement is such that when the H.T. supply to the sub-station is interrupted the battery can run the motor-converters reversed, taking current on the D.C. side and delivering high-tension alternating current to the H.T. switchboard, from which it is transmitted, as before, to the lighting distributing centres. In case the traction load is too great to be maintained by the battery under these conditions, a maximum automatic circuit-breaker, connected between the battery and the track feeders, is arranged to open at a predetermined amount. A resistance is connected as a shunt across the terminals of this circuit-breaker, so proportioned that when the circuit-breaker is opened sufficient current can be supplied to the trains to keep the lamps alight until the power for driving the trains can be supplied again.

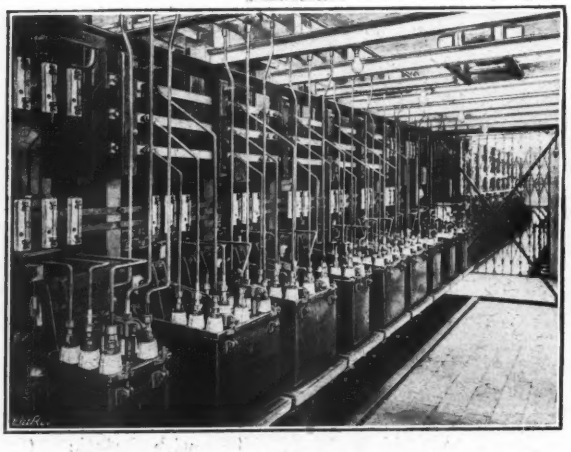


FIG. 20.—VIEW BEHIND AUXILIARY 3-PHASE SWITCHBOARD.

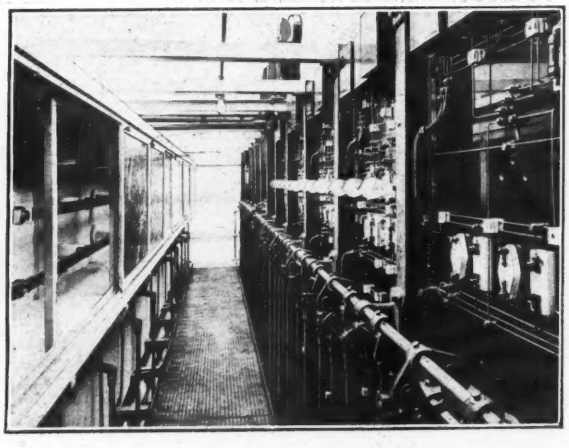


FIG. 21.—VIEW OF INTERLOCKING GEAR BEHIND H.T. BOARD.

The negative bus-bar of the traction switchboard is connected to earth through a resistance which allows about 100 amperes to pass when the positive side of the system is earthed, owing to accidental connections to the conductor rails on the track or in any other way.

The distributing centres consist of brick chambers, the usual dimensions being about 20 ft. × 12 ft. × 9 ft. high.

Two H.T. distributors are carried from one or other of the sub-stations to each distributing centre, being connected at the sub-station end by a maximum-current automatic cut-out. One of these H.T. distributors is connected to the left-hand section and one to the right-hand section of the sub-station bus-bars. Where more than one centre is fed by one pair of feeders leaving the sub-station, the distributing centres are worked in parallel. At the distributing centre each feeder is connected through a hand-operated oil-break switch to the primary windings of a group of three single-phase step-down transformers. The three transformers of each set are connected in delta on both the primary and the secondary sides. The secondaries from each set are connected through an automatic switch to a set of L.T. bus-bars. The two groups of transformers in each distributing centre are, therefore, only connected in parallel on the L.T. side. The normal ratio of transformation is from about 6,300 to 110 or 220 volts. In order to avoid the expense of having a man at each distributing centre, to change over from one set of transformers to the other in case of failure or other trouble, it is arranged that the whole of the distributing centres can be controlled from one or other of the three sub-stations. This is accomplished in the following way :—

As the primaries and secondaries of the transformers must always be in phase, there is no difficulty in paralleling at the distributing centre by means of the automatic cut-in switch which connects each set of transformers to the L.T. bus-bars on the secondary side. As soon as one set of transformers is energised from the sub-station, the automatic switch is closed on the L.T. side by a solenoid made alive from the transformers ; the solenoid is then cut out of circuit, the L.T. switch being held closed by a catch. The latter is tripped by a no-voltage coil coming into action when the set of transformers is de-energised.

An Andrews discriminating transformer is connected, so that when only one set of transformers is delivering power to the bus-bars a relay circuit is brought into action, which open-circuits the tripping coil of the L.T. automatic switch of the other, or idle, set of transformers, and so disconnects them. With this arrangement it is therefore possible to switch in or out from the sub-station either set of transformers in any order, paralleling them when required for changing over, or for taking the peak load. The high-tension switchgear at the distributing centre, shown in fig. 24, is of a very simple nature, and is contained in stone cells with iron doors, placed at the end of the distributing centre remote from the entrance.

The two sets of transformers are placed one on each side of the chamber, are air-cooled without cases, and are supported by wheels on rails.

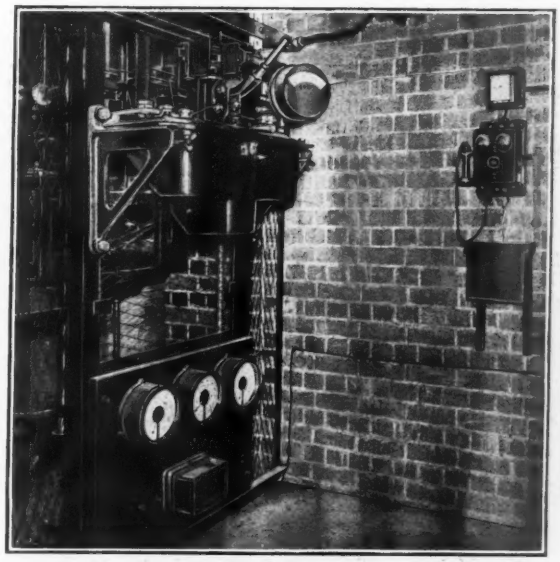


Fig. 23.—L.T. Gear in Distributing Centre.

The L.T. switchgear (fig. 23) is carried on a steel framework, which entirely screens off the transformers and the H.T. circuits, a door being provided in the centre to give access to the H.T. end of the chamber.

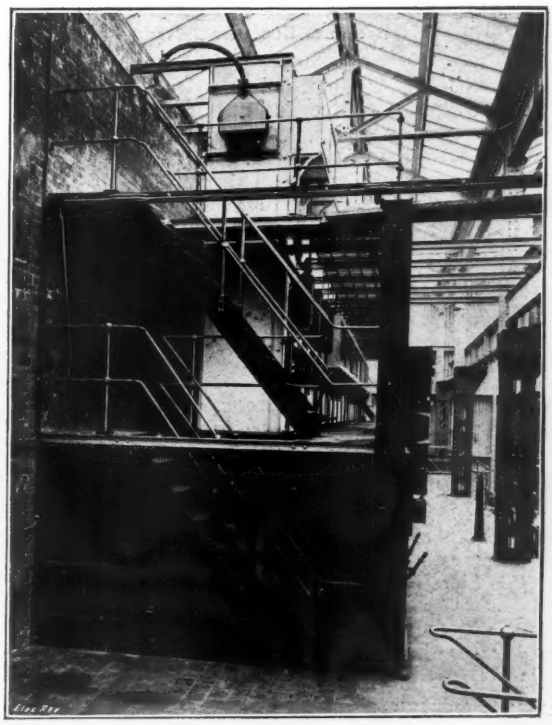


Fig. 22.—End View of H.T. Switch Cells, in Sub-station.

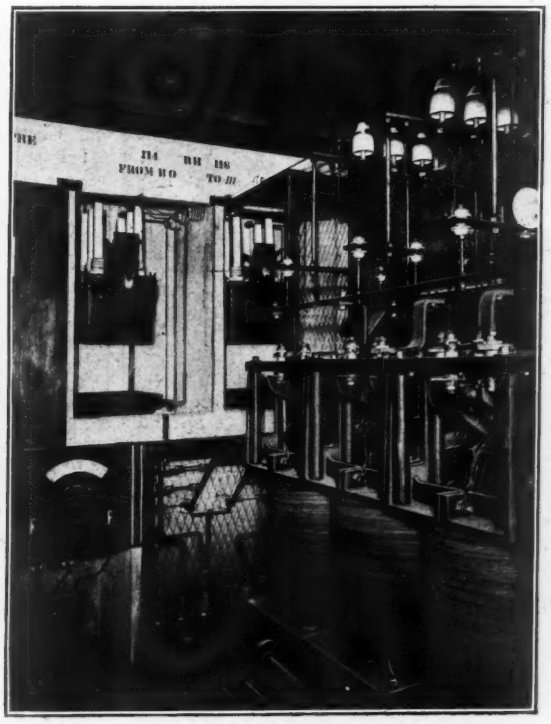


Fig. 24.—H.T. Gear in Distributing Centre.

Between the generating station, the sub-stations and the distributing centres about 37 miles of H.T. three-core cable and about 14 miles of L.T. concentric cable have been laid,

in addition to between 3 and 4 miles of single L.T. cable used in the form of jumper cables in connection with the conductor rails.

The three-phase current is transmitted from Park Royal by six H.T. feeder cables as far as an inspection chamber adjoining the sub-station at Old Oak Common. From this point five H.T. feeders are carried on to another inspection chamber at Westbourne Park. From Old Oak Common

Fig. 25.—Sub-station Battery, Royal Oak.

inspection chamber two H.T. feeders supply the Old Oak Common sub-station. From the Westbourne Park inspection chamber four H.T. feeders are carried to supply Royal Oak sub-station, and three to supply Shepherd's Bush sub-station.

The inspection chambers referred to above are small brick buildings, in which a simple arrangement of plugs and switches is provided, so that each sub-station can be supplied direct from Park Royal and also from one of the other two sub-stations, and so that any incoming feeder can be joined to any outgoing feeder. In this way it is possible to keep one or more cables as spare in any section, and to connect them to the spare cable in the next section or to any other sub-station as may be necessary.

The conductor rails on the Hammersmith and City Railway, and the lines in connection with it, are fed by concentric cables from the sub-stations at Royal Oak and Shepherd's Bush, four 1·25 sq. in. cables being laid from the former, and six 1·25 sq. in. cables and two ·75 sq. in. cables from the latter sub-station. The two ·75 sq. in. cables supply overhead conductors in the car-sheds at Hammersmith, as well as the conductor rails outside them.

The two conductor rails are of an inverted channel section, resting at intervals not exceeding 10 ft. on iron-capped porcelain insulators, as shown in fig. 29. The insulator is fixed to the sleeper by small clamps and coach screws. This design leaves the conductor rail and insulator free to move up and down relatively to each other when trains are passing, owing to the spring in the sleepers and in the road bed.

At intervals of about 130 ft. the conductor rails are anchored by means of special insulators.

The bond terminals are expanded into the conductor rails with the aid of hydraulic presses.

At points and crossings the different lengths of conductor rail are connected together by rubber-insulated, lead-sheathed and armoured cables buried direct in the ground, each end of the cable being sealed in a porcelain terminal cap from which a solid copper rod projects. To this projection two flexible copper bonds are clamped, the other ends of the bonds being expanded into the conductor rail. Any jumper cable can thus be at once disconnected by the removal of two bolts in the clamp. The accompanying fig. 28 shows the general arrangement of one of the terminal insulators.

At each sub-station the negative conductor rail is connected to earth through a resistance.

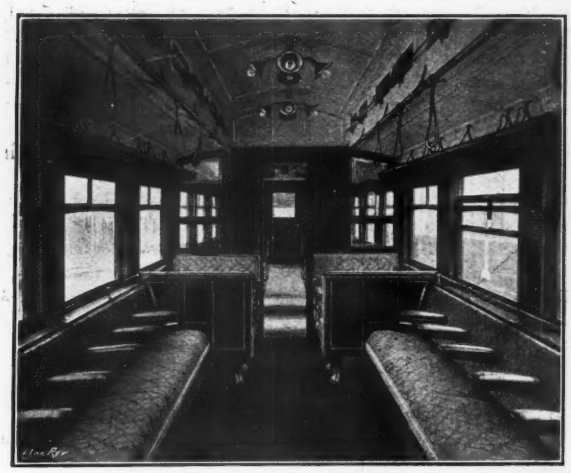


Fig. 26.—Interior of Great Western and Metropolitan Railways Electrical Coach.

Cross-bond pillars, operated from signal cabins, are placed at various points on the line, usually near a station, for the purpose of connecting the conductor rails of the "up" line with those of the "down" line.

Section insulators are placed at certain points. A section insulator consists of a 315-ft. length of conductor rail (in the positive and in the negative), separated from the conductor rails on the same line at each end by a 3-in. gap which is filled in with a hard-wood block, but normally connected to the conductor rails by a removable copper strap. A section switch pillar also provides for coupling up the two sections.

At the electrical boundary at Bishop's Road two disconnecting pillars are provided, one for the "up" line and the other for the "down" line. The switches are kept open at

Fig. 27.—Motor Coach, Great Western and Metropolitan Railways Joint Electrical Stock

all times except when it is arranged that, under emergency, the two systems can be connected together. The opposite end of each section insulator at the boundary has the positive and negative conductor rails respectively connected up through resistances, instead of by the copper straps used at other section insulators. The resistance is only in circuit as a train passes from the Great Western line to the Metropolitan lines, or *vice versa*, and is required to prevent

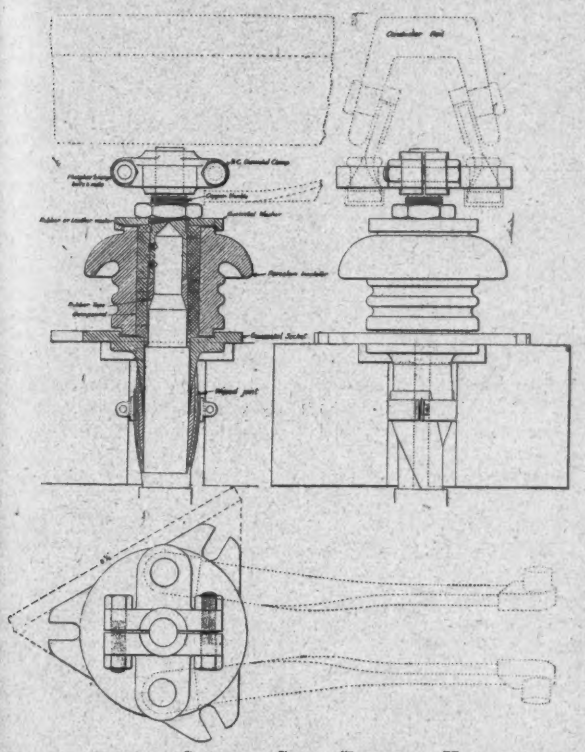


Fig. 28.—Views of Standard Cable Terminal; Hammersmith and City Railway.

an excessive rush of current from one system to the other. Under the emergency referred to above, the resistances can be short-circuited by copper straps.

For the service between Hammersmith, Kensington (Addison Road), Aldgate and Whitechapel, twenty electric trains have been provided by the Great Western and Metropolitan Railways. The cars are of the closed vestibule type with doors only at the ends and sides of the vestibules, six cars composing one train. Each car is carried on two four-wheel bogies, those of the front and rear cars each being equipped with two motors. The train has a total seating capacity of 320 passengers, with additional room for about 160 passengers standing, making a total passenger load of 30 tons, while the train itself, unloaded, weighs about 174 tons with electrical equipment complete.

The electrical equipment is of the B.T.-H. "M" multiple control type, the eight motors on the train being controlled from either end of the train. Positive and negative train cables have been fitted throughout the train as well as the 10-core multiple control cable, in order to avoid interrupting the supply of current to the motors and to the lights in the train where gaps occur in the conductor rails. The eight motors are capable of accelerating a fully-loaded train at the rate of 1·6 ft. per second per second with a track voltage of 600. the momentary maximum current per motor not exceeding 320 amperes, while the average maximum is about 280. The motors are capable of attaining a train speed of 40 ft. per second within 40 seconds of the start, and the energy consumed on the trip from Hammersmith to Aldgate and back does not exceed 75 watt-hours per ton-mile. Westinghouse air-brakes, with motor-driven compressors, are fitted to the trains, as well as hand brakes in the motor-cars.

New train-sheds have been built by the G.W.R. Co. at Hammersmith. A large shed takes fifteen trains, and a small one five trains. At the side of the small shed two roads run into a repair shed. Electric current is supplied to the trains throughout the sheds by means of positive and negative overhead trolley wires. Travelling collectors to which are attached grooved rubbing contacts collect the current, which is conveyed to the trains by means of two flexible cables bound together with leather braiding, and reinforced by a stranded steel wire. To the bottom ends of the cables are attached the standard train cable plugs, which allow a connection to be made to either end, or either side, of any car.

The repair shop is fitted with a 15-ton three-motor electric crane running the whole of its length. The crane controllers are operated by ropes from the floor level, springs being fitted to return each controller to its "off" position as soon as the ropes are released.

Wheel and axle-turning lathes have been installed, as well as smaller lathes, drilling and shaping machines, and other tools required for carrying out all ordinary running repairs. The two large lathes are each driven by a separate motor of the three-phase squirrel-cage type; the smaller tools are worked in groups from overhead shafting driven by similar motors of various sizes.

A very complete system of telephonic communication has been provided. At the generating station and each sub-station an exchange switchboard is installed, and is in communication with each of the distributing centres, railway stations, signal cabins and section switch pillars. In addition to the exchange switchboards, three telephone instruments are installed at the generating station, and at each of the three sub-stations, for direct communication between the main H.T. switchboards.

Messrs. Kennedy and Jenkin, as consulting engineers to the Great Western Railway Co., were responsible for the whole of the generating and distributing equipment, the electrical equipment of the track, and, jointly with Mr. Thomas Parker, consulting engineer to the Metropolitan Railway, for the electrical train equipment.

The buildings, permanent way, and rolling stock were constructed under the supervision of the company.

The principal contractors were as follows:—

Babcock & Wilcox, Ltd. ...	Boiler plant.
Spencer & Co., Ltd.	Coal-handling plant.
Electric Construction Co., Ltd.	Steam generating plant, three-phase motors and transformers, L.T. switchgear and boosters at sub-stations, switchgear and transformers at distributing centres, &c.

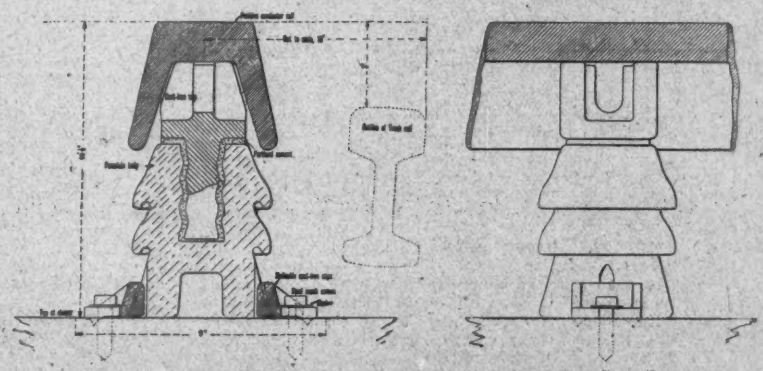


Fig. 29.—Views of Positive Rail Insulator; Hammersmith and City Railway.

British Thomson-Houston Co., Ltd.	Switchgear at generating and sub-stations, and train equipments.
Aiton & Co.	Pipe work, pumps, tanks, water-softening and oil-separating plant.
Siemens Bros. & Co., Ltd. ...	H. and L.T. cables.
Bruce Peebles & Co., Ltd. ...	Motor converters.
Tudor Accumulator Co., Ltd.	Storage batteries.
R. W. Blackwell & Co., Ltd.	Machine tools, and overhead equipment of train shed.

Westminster Engineering Co., Ltd.	Motor, lighting, telephone and bell circuits, &c.
The Metropolitan Amalgamated Railway Carriage & Wagon Co., Ltd.	Rolling stock.

TRAMWAY and RAILWAY NOTES.

(*Continued from page* 262.)

Silksworth.—Lieut.-Col. Von Donop, R.E., held a B. of T. inquiry at Philadelphia, County Durham, on the 8th inst., into the two tramway accidents which occurred on the Mill Hill (Botcherby) Bank, near Silksworth, on July 29th, whereby 13 persons were injured. The Inspector visited the scene of the accidents, and afterwards examined the broken cars. James Goodwin, the driver of the first car which left the rails, said that in accordance with the B. of T. regulations, he brought his car to a stop at the top of the bank, and on receiving the signal from the conductor he started again. He put the controller handle to the third notch of the magnetic brake and allowed the car to get a suitable speed for that notch. He found the car was not taking the brake, and he put the controller back in the off position. He then applied sand, and found that the wheels were revolving, whereupon he applied the magnetic brake to the first notch, but there was no braking whatever. As the car was gaining speed, he reversed the motors and the switch "blew." He then tried the hand-brake, but all to no purpose, and the car, which was travelling at about 30 miles an hour, left the line after taking the curve, and ran into a wall. He admitted that he did not carry out the rule requiring drivers to apply the magnetic brake at the first notch when descending hills, after the car had been brought to rest on the top of the hill. H. Frazer, driver of the second car, said the wheels skidded in consequence, he thought, of the greasy rails. Charles Trott said the brake gear of the car concerned in the first accident was repaired just before the accident. Mrs. Brydon, a passenger, stated that the first car did not stop at the top of the Bank. After hearing other evidence, the Inspector said he thought they might accept the statement that the first car did stop as was required. The inquiry then closed.

Stalybridge.—The Stalybridge, Hyde, Dukinfield and Mossley Joint Tramways Board, finding themselves recently rather short of steam plant, have decided to put down another large boiler with superheaters and pipe work, and three mechanical stokers. In addition they have contracted for new economisers.

Stockport.—The financial report of the T.C. for the past year shows that the electricity department contributed £2,000 in aid of the rates, the profits being £1,850 more than last year, and the tramways aided the rates to the extent of £4,000, or £2,500 more than last year. The total income of the tramways was £50,127, and the gross profits £24,908.

The electric tramways are to be extended to Reddish.

Turton.—The U.D.C. has decided not to proceed with the suggested electric tramway scheme, owing to the prospective charge on the rates for a number of years.

TELEGRAPH and TELEPHONE NOTES.

Cable Items.—The length of the Dakar (Senegal) Fernando de Noronha cable is stated to be 1,620·805 nautical miles.

The Compagnie Française des Cables Télégraphiques has altered the landing of the Cayenne-Pinheiro section, which now, at the Brazilian end, is at Salinas.

Morocco.—On the 5th inst. the French Administration announced the opening of a new telegraph office at Oudjda, Morocco, which has been connected with the Algerian landlines.

New Land Line.—A direct telegraph line between Budapesth and Constantinople is to be opened to-day. It will give, in connection with the present direct wire between London and Budapesth, an entirely new direct telegraphic connection between London and Constantinople. It will also create a new connection to points beyond the Turkish capital, as far as Fao on the Persian Gulf, thereby greatly improving telegraphic communication between London and Asia Minor and British India.

Overhead Telegraph Wires.—The vexed question of telegraph wires and posts in the Metropolitan area is to be brought, by way of an appeal, by the Postmaster-General before the Railway and Canal Commission. The lines which form the subject matter of the dispute are in Plumstead and Eltham. In the case of three roads the Woolwich Borough Council decided to refuse permission for the erection of overhead wires on the ground that the wires would be unsightly and objectionable, and the poles would form an obstruction to the footway, but in respect of the remaining roads it was willing to consent to overhead wires, on condition that the poles used were sightly iron poles, not less than 30 ft. high, placed at intervals of 70 yds., the wires to be placed underground when a sufficient number of *bona fide* telephone subscribers using the wires had been obtained. The matter came before Mr. Hutton, police magistrate, as arbitrator under the Telegraph Act, 1878. The magistrate viewed the roads in question, and after hearing witnesses for the P.M.G., decided, without calling upon the Borough Council to submit evidence, that the wires in Eltham should be placed underground, but that the lines in Plumstead should be allowed overhead on the conditions named, until 24 wires had been placed on the poles. In the case of Ann Street, the magistrate allowed creosoted wooden poles instead of sightly iron poles. The Postmaster-General considered the result of the arbitration of so much importance as to necessitate an appeal against it to the Railway Commissioners. Woolwich Council was the first authority in London to obtain a magistrate's decision upholding the objection to overhead wires and wooden poles, when it was proposed to erect them in some of the roads on the Abbey Wood Estate. In that case, however, the magistrate allowed the overhead telegraphs subject to certain conditions.

Swansea Telephones.—On Saturday last the transfer of the municipal telephone system to the National Telephone Co. was concluded, the amount paid by the company being £26,936, equal to the total outlay on the system. The company will later pay the Corporation a further sum as interest for the period since the agreement was settled.

Sydney-Melbourne Telephone. — The trunk line between these cities has been completed and opened to traffic. The charges are: Ordinary rates 6s. for three minutes; deferred conversations (at night) 4s.; Press rates, 3s. for three minutes.

Telegraphic Interruptions and Repairs:—

	Interrupted,	Repaired,
Cables.		
Curacao-Coro Curacao-La Guayra Curacao-Maracaibo } Closed..	Jan. 12, 1906 ..	..
Reissa-Issa and Reissa-Yemani (Yemen) ..	Oct. 22, 1902 ..	..
Tarifa-Tangier	Jan. 18, 1904 ..	..
Port Arthur-Chifu (Closed)	Mar. 9, 1904 ..	..
Garachico-Santa Cruz	July 12, 1906 ..	..
Las Palmas-Arecife	Aug. 18, 1906 ..	..
Brest-Dakar	July 22, 1907 ..	..
Gibraltar-Tangier	July 29, 1907 ..	Aug. 5.
Accra-Lagos	Aug. 11, 1907 ..	..
Lagos-Bonny	Aug. 11, 1907 ..	..
Landlines.		
Puerto-Barrios	Aug. 2, 1902 ..	..

Telegraphists' Strike in U.S.A.—A serious and widely extended strike is in progress in the United States. The operators' trade unions have been seething with disaffection for some time past, and on the 8th inst. the discharge of an employé at Los Angeles for delaying messages brought matters to a head. The local telegraphists went on strike, and their action was quickly imitated in many other towns in the middle west. No fewer than 800 operators belonging to the Western Union Telegraph Co. struck work in Chicago at midnight on the 8th inst., because 70 of their number were discharged for refusing to receive messages from non-union operators who took the place of the strikers at Los Angeles, and the operators in Denver, Kansas City, Helena and Salt Lake City followed suit on Friday, to the number of 1,500 men in all. They demanded an eight-hour day, with a rise of 25 per cent. in wages. By Sunday 50 towns were involved, and the employés of the Postal Telegraph Co. were drawn into the movement, between 4,000 and 5,000 men being out. The New York telegraphists met in conference to discuss the situation, and on Monday they also came out, in defiance of the orders of their union. Naturally, enormous inconvenience was caused to the business world, and Press messages were brought almost to a standstill. The union, which is cordially supported by other industrial unions, has enormous resources at its disposal, and the number of non-union telegraphists available is very small. After New York had joined the fray, the strike became general, and it was feared that the railway telegraphists would be affected. The average wages of a first-class operator are said to be £20 a month, ordinary operators receiving £3 a week, and women £2. Press Association men are demanding £6 a week, and an eight-hour day; for night duty they ask £7 a week.

On Wednesday last it was reported that the strike was general throughout the States, and had spread to Canada, affecting Montreal and Toronto. The railway staffs are remaining at work, but have flatly refused to transmit commercial messages, although the railways are bound by contract to forward them.

A previous strike on the part of the operators of the Western Union and Postal Telegraph Companies at Oakland and San Francisco, California, was settled last month by their return to work on the old terms. A committee of arbitration was to discuss the conditions of service.

Official notice of delay has been issued on telegrams to Alabama, Colorado, Illinois, Louisiana, Mississippi, Missouri, Montana, Tennessee, Texas and Utah.

Uruguay.—The British Minister at Monte Video, in a recent report on the trade of Uruguay, states that the number of telegraphic messages sent in 1906 through the 45 offices was 191,698, being 23,190 in excess of those sent during the previous year, and the receipts amounted to $80,810 (£17,194), being an increase over last year's receipts of $23,190 (£4,934). There are 7,917 km. of telegraph lines in Uruguay. The telegraph rate from Uruguay to the United Kingdom by the Western Telegraph Co. *vid* Madeira is 4s. per word.

Wireless Telegraphy.—A conference on the subject of wireless telegraphy was opened on June 11th at Melbourne, to consider the question of the system to be adopted for Australia.

As the result of a long series of trials carried out by the French Post Office Administration, the Minister of Public Works has appointed an inter-Ministerial Technical Commission for the purpose of organising the whole service of wireless telegraphy. It is hoped that this Commission, representing as it does the interests of all the departments concerned, will be able to arrive at results that will give to France a very complete and properly co-ordinated service of wireless telegraphy for land and sea service both in peace and war.

It is reported that the Marconi station at Clifton, in Ireland, is now finished, and that the Canadian station at Cape Breton will be ready by the end of this month; communication has already been established, and it is hoped to inaugurate a trans-Atlantic service in about a month's time. The rates to be charged are 5d. a word for ordinary messages, and 2½d. for Press messages, plus land charges in each case.

CONTRACTORS' COLUMN.

Openings for New Business.

ATHERTON (near Manchester).—New place of worship. Builders, Messrs. J. Lowen & Sons, Walkden.

BALLYMENA (Co. Antrim).—New bank house for the Belfast Banking Co., Ltd. S. P. Close & Son, architects, Donegall Square Buildings, Belfast.

BARNSLEY.—Lock-up shops, stables, warehouses, &c., in Church Street. Senior & Clegg, architects, 15, Regent Street, Barnsley.

(Stairfoot).—Sunday-school premises. E. W. Dyson, architect, 10, Regent Street, Barnsley.

BENTHAM.—New factory for G. Angus & Co., hose-pipe manufacturers, Newcastle-on-Tyne.

BLACKBURN.—Extensions proposed at Messrs. Jones Bros., Hart Street. Dobby & Jacquard, furnishing works.

BLACKPOOL.—A Carnegie library is to be built here. Write Borough Surveyor, Blackpool.

Venetian café. Builders, Dryland & Preston, Littleborough, Rochdale.

BLAENAVON.—New motor-house and laundry at Park House. Teather and Wilson, architects, Andrews' Buildings, Queen Street, Cardiff.

BOLTON.—Structural alterations at Hen and Chickens Hotel, Bolton.

Extensions at Musgrave Spinning Co.'s Nos. 3 and 4 Mills.

Proposed Municipal Sanitorium extension.

BRADFORD.—New mortuary at Milton Street (£1,671).

BRAY.—Carnegie free library (£2,000), opposite Technical Schools.

BRISTOL.—Converter station for the Corporation electrical department. H. Faraday Proctor, city electrical engineer.

BURY.—Smallpox hospital for the Bury and District Joint Hospital Board.

CARDIFF.—Warehouse at Ely Paper Works, for T. Owen & Co., Ltd. J. W. Rodger, architect, 14, High Street, Cardiff.

CASTLE DONNINGTON (Derbyshire).—Alterations and improvements at sewerage works.

CHATHAM.—Seamen's Mission Church and Institute (£2,446). Messrs. Skinner are the contractors.

CLAYTON.—Roman Catholic elementary school (282 accommodation).

CLECKHEATON.—Eighteen houses on Howard Park Estate. R. Castle & Son, architects, Bradford Road, Cleckheaton; Robinson & Crowther, builders, Cleckheaton.

CLIFTON (near York).—Extensions to the County Lunatic Asylum (£22,000) for the North Riding County Council.

COLDSTREAM.—Residence in West High Street for Mr. George Carmichael. Wm. Smith & Son, builders, Coldstream.

DARTFORD.—Bakery for the Dartford Industrial Co-operative Society, 93, Kent Road. W. E. Albrow, secretary.

New church for Christ Church parish.

ECCLES.—Old silk mill at Patricroft being converted into a doubling mill for Patricroft Doubling Co., Ltd. Write Alderman J. Schofield, Mayor of Eccles, Lancs.

EGHAM (Surrey).—Church room. W. Ralph Low, architect, Staines; J. Sleep & Sons, builders, Egham.

EPPING.—Aisle tower, &c., for Parish Church (£8,200). G. F. Bodley, 7, Gray's Inn Square, W.C., architect.

HALSTEAD (Essex).—New girls' high school for Essex C.C.

HARROGATE.—Homes in connection with the Primitive Methodist Orphanage (£1,700). Holden & Hill, architects, Manchester.

HENDON.—Addition to parish church. Temple Moore, 37, Old Queen Street, S.W., architect.

HERTFORD.—Block of public offices and shops for the T.C., at the Wash (£3,500).

HITCHIN (Herts).—New German Convalescent home on Benslow Hill (£9,000). F. Newton, builder, Tilehouse Street, Hitchin.

HORNCASTLE.—New school for the Governors of Queen Elizabeth's Grammar School, Horncastle.

HULL.—Extensions to Blenkin Street Schools for the Corporation Education Committee. J. H. Hirst, City architect, Town Hall, Hull.

KENDRAY.—Alterations to hospital for Barnsley Town Council.

KINGSTON-ON-THAMES.—Children's home for the Guardians. J. Edgell, solicitor, Union Offices, Coombe Lane, Norbiton, Kingston-on-Thames.

LANCASTER (Bentham).—Extensive factory. Cumberland Bros., builders; Geo. Angus & Co., Ltd., Grainger Street W., Newcastle-on-Tyne, owners.

LEICESTER.—Workhouse extensions; also a new receiving home for children.

LEVENSHULME (Lancs.)—Development of Burnage Hall Estate into Garden City, 215 pairs of houses to be built, E.L. to be installed. T. H. Drinkwater, Levenshulme.

LIVERPOOL.—New Custom House, at the docks, for the T.C.

LONDON (Balham).—Gymnasium. J. W. Falkner & Sons, 24, Ossary Road, S.E., builders.

(W.).—Shops, showrooms, &c., on sites of 40, 41, 42, New Bond Street. John Smith & Sons, Ltd., South Norwood, builders.

(W.).—Alterations and additions to premises of Paquin, Ltd., dressmakers, Dover Street.

(Mayfair).—Extensive alterations to 75, South Audley Street. Foster & Dicksee, Rugby, builders.

(Wandsworth).—79 houses. Holloway Bros., 19, Belvedere Road, S.E., builders.

(Balham).—Laundry. Rice & Sons, 15, Stockwell Road, S.E., builders.

(North London).—Rebuilding Canonbury Tower for Marquis of Northampton.

(Brondesbury).—Houses in The Avenue. H. Reeder, The Avenue, Brondesbury, N.W., builder.

(Fenchurch Street, E.C.).—Offices in Lloyd's Avenue. Holland and Hannen, Bloomsbury, W.C., builders.

(Old Broad Street, E.C.)—Premises for the Anglo-South American Bank (The Bank of Tarapaca), on site of St. Peter Le Poer Church.

(Gray's Inn Road).—Two new operating rooms are erecting at the Royal Free Hospital.

(London Road, S.E.)—Shops. Johnson & Co., 79-99, Southwark Bridge Road, S.E., builders.

(Chiswick).—Flats. Millman & Co., 159, High Road, Chiswick, builders.

(East Ham).—Work at Pupil Teachers' Centre, Wakefield Street. S. A. Batchelor, secretary, Technical College, East Ham, E.

LUDLOW.—Workhouse extensions, Guardians' plans just approved by L.G.B.

MAIDSTONE.—Business premises in High Street (£2,668). Ruck & Smith, architects, Wick Street, Maidstone; R. Corben & Co., builders, 6, Tonbridge Road, West Borough, Maidstone.

MANCHESTER.—Congregational Institutional Church in Stretford Road (£25,000).

(Gorton).—Business premises in Hyde Road. Manchester and County Bank, Ltd., Manchester, owners.

MARCH.—New County Buildings for Isle of Ely C.C. (£3,500).

NEWPORT (Mon.).—Rebuilding Newport Station, also doubling tunnel and line for G.W. Railway.

NEW SEAHAM.—Working Men's Club (£2,500).

NORTHWICH.—New Library on site of present one. Sir John Brunner bears cost of buildings and equipment.

New Village Clubhouse at Weaverham, near Northwich, for Lord Barrymore.

PAISLEY.—Consumptives' Sanatorium for the Parish Council.

PONTYPRIDD.—Additions, &c., to "Ashgrove," Pontypridd, for Dr. Howard Davies; A. L. Thomas, architect, Church Street Chambers, Pontypridd.

School to accommodate 250. Dr. Milton Jones, secretary, Education Offices, Municipal Buildings.

PORTH.—New church at Llwyncelyn Estate, Porth, site given by Captain de Winton, J.P., Maesllwch Castle, Glasbury, Hereford.

PRESCOT (Whiston).—New hospital for the B.G. (£10,000).

PRESTON.—Extensions at Bannister Hall's print works, Walton-le-Dale. John Knowles, builder, Darwen.

RAMSGATE (St. Lawrence).—Detached residence for Mr. Osmond, 3, Osmond Terrace, Whitehall Crescent, St. Lawrence.

RICHMOND-ON-THAMES.—16 houses in Burlington Avenue. C. and J. Flower, Richmond-on-Thames.

Villa residences. Greenwood & Co., 360, High Road, Chiswick.

READING (Caversham).—Depôt buildings for the U.D.C. (£1,439). A. H. Wyeth, builder, Reading.

ROTHERHAM (Mexborough).—Business premises. W. T. Turner, architect, George Chambers, Market Hill, Barnsley.

ST. ANNE'S-ON-THE-SEA (Lancs.).—Eight semi-detached and one detached villas in St. Andrew's Road N. S. Tompkin, owner.

ST. HELENS (Parr).—Explosives factory at Derbyshire Hill. British Electric Detonator Co., owners.

SITTINGBOURNE.—New Council schools (£4,000).

STOCKPORT.—Large hall (£13,000). Potts, Son & Hennings, architects, St. George's Road, Bolton; Josiah Briggs, builder, Canal Saw Mills, Stockport.

TIPTON.—Minister's house for Primitive Methodist Church.

WALKDEN.—New co-operative premises. J. T. Proffitt, architect; Messrs. Coop Bros, Farnworth, builders, Bolton.

Lord Ellesmere is having a new railway made at Little Hulton. Write Captain Hart-Davis, Bridgewater offices, Walkden.

WIDNES.—New church for St. Mary's Parish (12,000).

WILLESDEN GREEN.—Shops in Walm Lane. G. A. Sexton, 42, High Road, Kilburn, architect.

WORKSOP.—Chapel at St. Cuthbert's College (£10,000 provided by Viscount Mountgarrett).

WARE (Herts).—Electric lighting building at Hailey Lane, Amwell. H. Tatton Sykes, owner.

WORSLEY.—Eight model dwelling houses for Lord Ellesmere.

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—January 8th, 1908. One common battery switchboard and 3,000 subscribers' telephones (specification No. 166) for the Deputy Postmaster-General, Adelaide. Specifications can be seen at the Commonwealth Office, 72, Victoria Street, S.W.

Austria.—August 31st. The Austrian State Railway authorities at Czernowitz are inviting tenders for the establishment of an electric plant at the railway station in that town, for lighting and power purposes.

Bourges.—August 30th. The Artillery Depôt requires tenders for one dynamo and two electromotors. Papers by August 22nd.

Bristol.—Converters, switchgear and cables for the T.C. See "Official Notices" August 9th.

Clonmel.—September 7th. Electric lighting of the District Lunatic Asylum. Section 1, suction-gas plant, engines and dynamos. Section 2, accumulators, switchgear, mains, wiring and fittings. Section 3, buildings and foundations. See "Official Notices" August 9th.

Dundee.—August 21st. The T.C. invites offers for six electric tramcar bodies. Mr. Peter Fisher, the manager, will supply specifications.

Egypt.—November 1st. The Alexandria Harbour authorities require tenders for the construction of an electric power station and for the following plant, to be worked by electric power:—Five transporters of large range; five ditto of smaller range; six cranes of 4 tons each; 36 cranes of 2 tons each; 25 capstans; cables, feeders, &c. Particulars may be obtained from the Directeur des Postes et Phares.

Farnworth (Bolton).—Proposed extension of local electricity works, or putting down of additional machinery. Mr. R. B. Leach, electrical engineer.

Finchley.—August 31st. Surface condensing plant for the U.D.C. electricity works. See "Official Notices" to-day.

Finchley.—September 16th. Feeders, mains and other cables; network and joint boxes for the U.D.C. See "Official Notices" to-day.

France.—August 30th. The French Post and Telegraph authorities are inviting tenders for the supply of 220 tons of bimetallic wire, 2 mm. diameter, and 60 tons ditto, 3 mm. diameter. Particulars may be obtained from, and tenders are to be sent to, Le Sous-Secretariat d'Etat des Postes et des Telegraphes, 103, Rue de Grenelle, Paris.

France.—The municipal authorities of Bergerac (department of Dordogne) have just invited offers for the concession for the electric lighting of the town during a period of 30 years.

Italy.—August 24th. The municipal authorities of Campanario are inviting tenders for the concession for the electric lighting of the town during a period of 20 years.

Llandudno.—September 2nd. Supply and erection of battery, booster, &c., for the pier company. See "Official Notices" August 9th.

New Zealand.—The T.C. of Napier requires tenders for a complete electric lighting, tramway and power installation.

Oystermouth.—The U.D.C. is inviting applications from those willing to establish an electrical undertaking there. See "Official Notices" August 9th.

Queensland.—September 9th. The Deputy Postmaster-General requires tenders for the supply of lead-covered paper-insulated telephone cable, also various post and telegraph stores, telegraph and telephone instruments, parts, &c. Specifications of the above, and of a number of other contracts for telegraph and telephone material, may be inspected at the office of the Electrical Review.

France.—Saint Gaudens.—August 22nd. Tenders are required for electric pumps, motors and overhead equipment.—(Haute Garonne) Sous-Prefecture.

South Africa.—The *British and South African Export Gazette* says that the East London Municipality has instructed its London agents, Messrs. Dyer & Dyer, Ltd., 17, Aldermanbury, E.C., to obtain fresh tenders from British firms for the tramway material required in connection with the extension of the local tramway system. The Durban Municipality will shortly be in the market for rails and other tramway material. The London agents are Messrs. Webster, Steel & Co., 5, East India Avenue, E.C.

Salford.—Tenders will shortly be invited by the Tramways Committee (Mr. G. W. Holford, general manager) for cars of the single-truck double-deck type, with covers.

Stockport.—August 26th. Automatic point controllers for the T.C. See "Official Notices" August 2nd.

Sweden.—September 15th and October 1st. The General Direction of the Canal and Waterworks at Trolhattan, Sweden, are inviting tenders until September 15th for the supply and erection of turbines of 10,000 H.P.; and until October 1st for three 350-KW. continuous-current dynamos, a 4,800-ampere-hour battery of accumulators, four three-phase alternators of 11,000-kilovolt-ampere capacity, 12 relays, regulators, switchboards, &c.

Sunderland.—August 22nd. Uniforms and caps for the tramway employés of the Corporation. See "Official Notices" July 19th.

CLOSED.

Beckenham.—The U.D.C. received 14 tenders for meters, and that of the Westinghouse Co. was accepted.

Belfast.—Tenders for electrical wiring at the chief fire station were opened by the Police Committee last week, and that of Mr. Stanley Johnston, being the lowest, was accepted.

Bristol.—Messrs. Higginbottom & Mannock, Ltd., of West Gorton, Manchester, have received an order for twelve 30-cwt. electric jib cranes for the roofs of the new warehouses, Avonmouth Dock, Bristol.

Bristol.—The Electrical Committee has placed a contract with the Princess Royal Colliery Co., Ltd., for the supply of coal to Temple Back Works for six months (£1,094).

Continental Notes.—Bergamo.—The Société Anonyme d'Electricité Rag. Carlo Zanchi & Cie., of Bergamo, have placed with the Société Anonyme Westinghouse, of Le Havre, an order for the complete installation of a generating station. The equipment will include a Westinghouse turbo-alternator set of 1,200 KW. at 1,500 r.p.m., yielding three-phase current at 7,500 volts 50 periods. The turbine of this set will be provided with a Westinghouse-Leblanc condenser, having a capacity of 11,000 kg. of steam per hour. A second generating set will consist of a Belliss and Morcom steam engine of 250 r.p.m., direct-coupled to a Westinghouse three-phase alternator of 600 KW., 7,500 volts, 50 periods. This steam engine will also operate in conjunction with a Westinghouse-Leblanc condenser, of 5,000 kg. capacity. The switchboard for both sets will be supplied by the Société Anonyme Westinghouse. The boilers, by Babcock & Wilcox, will be four in number, each of 150 square metres heating surface.

Milan.—The Société Anonyme Westinghouse, of Le Havre, have secured a contract from the City of Milan for the supply of a 3,500-KW. turbo-generator set, running at 1,250 r.p.m., to generate three-phase current at 8,650 volts, 42 periods. The turbine will operate in conjunction with a Westinghouse-Leblanc surface condenser and air pump. The set will be installed in the Via Adige central station, Milan.

Dundee.—The tenders for the electrical equipment of new car routes have been remitted to a sub-committee.

Eastbourne.—The T.C. has accepted tenders for the new boiler, switchboard extension, and spray plant for the cooling pond for the electricity works.

Exmouth.—The U.D.C. has accepted the tender of Messrs. Meldrum Bros., Ltd., for a refuse destructor, at £2,064.

St. Helens.—The T.C. has accepted the tender of the British Insulated & Helsby Cables, Ltd., for the supply of cable.

Stalybridge.—The Stalybridge, Hyde, Mossley and Dukinfield Tramways and Electricity Board has accepted the tender of Messrs. Goodbrand & Co., of Stalybridge, for the supply of economisers, and that of Messrs. Thomas Beeley & Son, Ltd., of Hyde, for three superheaters and pipework.

Tantalum Rectifiers.—According to G. Schultze, in *Annalen der Physik*, tantalum has a rectifying action in all electrolytes, an advantage which aluminium does not possess. The insulating layer deposited upon the anode resists very high pressures—650 volts in carbonate of soda, 600 volts in various fluorides, and 70 volts in concentrated caustic potash. The electrode must be entirely immersed in the liquid, in order to avoid sparks at the surface. The insulating layer is quickly formed, and, unlike that of aluminium, is not affected by heat; but it is very unstable, and is rapidly reduced after the current is interrupted. Niobium and vanadium have somewhat similar properties.—*L'Industrie Electrique.*

NOTES.

Copper.—Messrs. Merton's report for the end of the month (July) now to hand, shows general conditions more hopeful than would be supposed from the condition of the market. The supplies to European countries have risen in quantity in all cases except Australia, and this only shows a comparatively small reduction (3,400 tons, against 3,750). The total for the 12 months ending July 31st, is an increase of nearly 2,000 tons on the preceding period of the same length. While it is fairly evident that the consumption is still ahead of the supply, there is at the present time an easier situation from the consumer's point of view, which will probably continue in sympathy with the general low prices and the depressed condition of the American market.

Appointment Vacant.—Second engineer-in-charge for Ilford U.D.C. (£120).

Institution Notes.—ASSOCIATION OF ENGINEERS-IN-CHARGE.—Between ninety and a hundred members of the above Association took the opportunity afforded them through the courtesy of Major W. A. J. O'Meara, C.M.G., M.I.E.E., engineer-in-chief to the General Post Office, to inspect the Central Telephone Exchange, Carter Lane, last Saturday afternoon. The party was met at the Addle Hill entrance by Messrs. Gregory and Bell, representing the Commercial and Engineering Departments respectively, on behalf of Mr. G. F. Bealin, the general manager, who were in turn further assisted by Messrs. Carmington, Cushway, and C. W. Salter. The arrangements which had been made for the instruction and guidance of the visitors were very much appreciated.

International Commission on Photometry.—From the 16th to the 18th of July the International Photometry Commission was assembled at Zürich, the British delegates being Mr. Helps, chief engineer of the Croydon Gas Works, and Mr. Paterson, of the National Physical Laboratory. Amongst other resolutions that were passed, *l'Industrie Electrique* quotes the following:—

LIGHT STANDARDS.—The Commission adopted the following ratios for the respective national standards:—

Carcel = $10{\cdot}7_5$ Hefner.
Harcourt = $10{\cdot}9_5$ Hefner.
Harcourt = $1{\cdot}02_0$ Carcel.

These numbers are considered to be correct within ± 1 per cent.; the last figures, subscript, are somewhat uncertain. The Carcel and Harcourt flames are supposed to burn in air containing 10 litres of water vapour per m^3; the Hefner in air containing 8·8 litres per m^3.

SYMBOLS.—The following notation is recommended:—

I_h, horizontal intensity.
$I_{a\alpha}$, intensity at the angle α above the horizontal.
$I_{a\alpha}$, " " " below "
I_o, mean spherical intensity.
I_U, upper mean hemispherical intensity.
I_L, lower " " "
$I_{ma\alpha}$, maximum intensity at an angle α above the horizontal.
$I_{ma\alpha}$, " " " below "

From the foregoing data it will be seen that the Hefner candle is to be taken as 0·913 of the British candle, whereas the formerly accepted ratio was 0·88. The new value is practically the same as that given by Mr. C. C. Paterson in his paper read before the Institution of Electrical Engineers on January 24th last (*Journal*, Vol. 38, No. 182, and ELEC. REV., Feb. 22, 1907, p. 322). The difference is of considerable importance. It is convenient to remember that a lamp which consumes 1 watt per Hefner candle takes 1·1 watts per British candle, on this basis.

Technical Students in the U.S.A.—The *Electrical World* has compiled statistics relating to the technical colleges of the United States and their output, which show that there are 96 schools teaching electrical engineering. These are classified into those of the highest standing; all others which demand the undivided time of the student; and those in which the instruction is elementary (usually evening class work), and the results are shown in the accompanying table:—

	Number of schools.	Students, 1906-7.	Graduates, 1907.	Total graduates.
Class I ...	24	3,884	558	5,974
Class II ...	61	4,473	639	4,296
Class III ...	11	572	131	689
Totals ...	96	8,929	1,358	10,959

Many of the higher colleges have recently organised electrical engineering courses, and in a few years these will notably swell the output of graduates. "The serious defect, which is characteristic in general of schools in Class II, and of not a few in Class I, is lack of preliminary preparation, as revealed in the requirements for entrance."

Commenting upon the enormous influx of technically trained men into the electrical industry, our contemporary says that there is no ground for alarm, for it is now generally recognised that the technical graduate is ideal raw material from which to recruit every branch of an industry—technical, administrative, manufacturing or commercial. The mental training and discipline of character imparted in the schools are of the highest practical value in life, apart from the technical bearing of the studies pursued; and technical knowledge enables a man to grasp confidently and firmly all non-technical situations that may arise, with the result that the electrical schools are rapidly becoming the sole avenue to advancement in the industry.

Electric Shock Fatality.—The *Daily Express* says that a workman was recently boring through the floor of a brewery at Ottawa when his auger touched an electric wire, and he was killed instantly.

Electrical Workers in Conference.—According to a Sheffield paper about 40 delegates from England, Scotland, Wales and Ireland, representing branches of the Electrical Trade Union, held in Sheffield last week a conference on matters of importance to the Union. The proceedings were said to relate to the internal affairs of the Union, and chiefly to a revision of the rules.

Annual Outings.—The employés of the South London Electric Supply Corporation, Ltd., went for their annual outing by wagonette to Walton-on-Thames on Saturday, August 3rd. At dinner those assembled heartily drank the health of Mr. H. W. Sprunt (the engineer-in-chief) and Mr. Pickford (mains superintendent).

Accident.—It is reported that a young woman was travelling outside an electric tramcar going through Prescot on its way to Knotty Ash, when somehow the trolley rope got round her neck. She was nearly choked when released by the conductor, and had to be taken to the Infirmary.

Egypt.—ISMAILIA.—We are indebted to an Egyptian correspondent for the following notes on the electricity supply system here:—"Ismailia is a picturesque town situated midway between Port Said and Suez. It is not a commercial centre, and but for the fact that the Suez Canal Co. have their headquarters in the town, it would be of no importance. The generating station is situated to the north of the town close to the fresh-water canal and Lake Timsah. The plant consis s of three gas engines, one of 40 H.P. and two of 20 H.P. each, all made by the Société Suisse pour la Construction des Locomotives. The gas generating plant was made by Messrs. Sulzer Fréres, of Winterthur. The dynamos are belt driven from the above engines, and were made by Messrs. Siemens & Halske. The generating pressure is 440 volts, and the distribution system three-wire. Motors are worked off the outers, and lighting at 220 volts. A Tudor battery, consisting of 260 cells of 178 ampere-hours' capacity, is installed to cope with the day load, which consists almost entirely of motors and fans. The station also contains a motor-generator for charging up the accumulators of two electric motor-cars which run between the town and No. 6 post on the old Suez road. The streets of the town are illuminated by 75 incandescent lamps, of which 55 are in the European quarter and 20 in the native village. There are also 12 arc lamps in the railway station. The Suez Canal Co.'s workshop contains four motors aggregating 20 H.P. There is a 12-H.P. motor in the pumping station, driving a centrifugal pump for supplying filtered water to the town. An ice manufactory is worked in connection with the generating station. There are two 'Linde' ice machines, each driven by an 8-H.P. motor. Each machine is capable of turning out 800 kg. of ice per day. Mr. Fehr is the electrical engineer."

Electrolytic Refining and Smelting in Australia.—A writer in the *Financial Times* says: "At one time it was expected that the Mount Morgan Co. would build its own smelting and refining plant, but instead of doing so it has taken, I believe, £50,000 interest in the Electrolytic Refining and Smelting Co. of Australia, formed early this year in Sydney with a capital of £150,000. At present the Mount Morgan Co. sends its blister copper to America for electrolytic treatment and the recovery of the gold, which, of course, takes many months for freightage and treatment before cash is received for shipments; but the new company will not only treat the Mount Morgan blister copper, but probably also that of the Mount Lyell and other Australasian mines. Captain Richard, general manager of the Mount Morgan mine, has been in America visiting many of the largest electrolytic and smelting works in the United States. He has had plans prepared for erecting works at Port Kembla, of which Mr. B. Magnus, manager of the electrolytic refinery of the Calumet and Hecla mine, is to be the manager. Last year Mr. Magnus built the new electrolytic plant of the Mountain Copper Co., near San Francisco. It will be distinctly to the advantage of Australasian copper mining to have a local electrolytic refinery and smelters to which Australian matte can be consigned for treatment instead of having to bear the expense of shipment to the United States and the delay in realisation; besides, it will be a great gain, as much of the copper produced can be sold in the eastern markets, to which it has to be reshipped from America. It is noticeable that the Mount Morgan, while only treating some 7,500 tons of ore per month, has an output of over 400 tons of blister copper. The Mount Lyell, on the other hand, treats about 33,000 tons of ore per month for about 600 tons of blister copper. Then there is the Great Cobar, treating about 14,000 tons of ore per month for about 400 tons of blister copper. This, along with South Australian, Queensland, and other copper mines, should open up a fine field for the new Refining and Smelting Company. The Mount Morgan mine as a copper producer is merely in its infancy, as with its 6,000,000 tons of payable copper ore in reserve it in time will become by far the greatest copper mine in Australasia."

Regenerative Control Litigation.—From a notice published in our advertisement pages to-day, it will be observed that the Johnson-Lundell Electric Traction Co., Ltd., has taken legal proceedings against Raworth's Traction Patents, Ltd., and three tramway authorities for infringement of their patents of 1899 and 1902 for "regulating electric motors and controlling arrangements for electric motors and motor circuits."

The Electric Supply Football League.—The first general meeting will be held on Tuesday next, August 20th, at 7 p.m., in the offices of the St. James' and Pall Mall Electric Supply Co., Ltd., 19, Carnaby Street, W. Clubs connected with electricity supply companies wishing to join should attend this meeting.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station Officials.—On the 9th inst. the Stirling T.C. appointed Mr. J. W. PEPWORTH, at present assistant electrical engineer at Kilmarnock, to be manager of its electricity works, at £200 salary. There were 80 applicants.

Mr. JOHNSTONE WRIGHT, jun., has been promoted by the Cleveland and Durham Electric Power Co. to the position of station superintendent of their new station to be erected on the outskirts of Middlesbrough, and also clerk of works for the erection of buildings, machinery, &c. Mr. Wright's headquarters will be at the offices of the company, Middlesbrough, until the station is built.

The Whitby Urban Council last week approved, after discussion, a recommendation increasing the salary of Mr. KING, the electrical engineer, to £175 at once, and to £200 next February. One of the arguments used in Mr. King's favour was that he was engaged at a low salary, and £104 was paid for an assistant, whom Mr. King had since "done away with," carrying out the work himself.

A resolution was moved at the meeting of St. Helens Corporation on August 8th that the salary of Mr. E. M. HOLLINGSWORTH, electrical engineer, be increased from £400 to £425 a year, Alderman Beecham pointing out that this was a moderate increase, considering how largely their engineer's business had been added to. Several members objected, one quoting figures to show how rapidly Mr. Hollingsworth's salary had been put up, and in the end the motion was defeated by 18 votes to 9.

The Warrington T.C. has appointed Mr. H. B. JACKSON as mains superintendent, and the Tramways Committee has increased the salary of Mr. F. W. PURSE from £170 to £200 per annum.

On Friday, 2nd inst., the staff of the Yorkshire Electric Power Co. presented Mr. E. SHAW, mains assistant, with a dressing case and a cigarette case, on the occasion of his leaving the service of the company. Mr. Shaw is going to Australia.

On 10th inst. Mr. J. H. QUICKE, draughtsman to the Leyton District Council electricity department, was presented by the staff with a clock on the occasion of his marriage. The presentation was made by Mr. L. O. COX, distribution engineer, in the absence of the chief engineer, Mr. Lewis.

General.—The staff of the Acton Electricity Works have presented an address and a gold signet ring and gold mounted cigar-holder, to Mr. T. H. MORRIS, Chairman of the Electricity Committee, as a token of regard and esteem.

Mr. FREDK. SATCHWELL, M.I.E.E., who is leaving Wimbledon to take up an electrical appointment in India, has been presented by his fellow citizens with an illuminated address and a purse of gold in recognition of his valuable public services to the town. The presentation was made by the Mayor at a town's meeting on August 8th.

Mr. E. W. DUNTON, late engineer and manager of the British Accumulator Co., Ltd., has been appointed assistant London manager to the London office staff of the D.P. Battery Co., Ltd, His address is now 11, Victoria Street, Westminster.

Obituary.—B. SYKES.—The death occurred at his residence, Elston, near Preston, on Monday, of Mr. Benjamin Sykes, M.Inst.C.E., who engineered several prominent Lancashire schemes. In addition to being connected with the establishment of the Electric Car Co., Ltd., which employs between two and three thousand men in Preston, he carried out important work in connection with the Blackpool and Lytham tramways.

SIR J. D. MILBURN.—We regret to record the death, at the age of 57, of Sir J. D. Milburn, chairman of the Newcastle and District Electric Lighting Co., Ltd., who was connected with many shipowning, colliery and industrial interests.

NEW COMPANIES REGISTERED.

Rhondda Tramways Electric Supply Co., Ltd. (94,470).—This company was registered on August 2nd, with a capital of £100 in £1 shares, to build, construct and equip a generating station for producing electrical energy, to supply electricity to the Rhondda Tramways Co., Ltd., for the working of its undertaking, to adopt agreements with the Rhondda Tramways Co., Ltd., and the National Electric Construction Co., Ltd., and to carry on the business of electricians, electrical engineers, &c. The first subscribers (each with one share) are:—W. J. Park, 43, Devonshire Street, Islington, N., shorthand writer; P. R. Reeves, 42, Crediton Road, Kensal Rise, N.W., clerk; S. Jordan, 115, Elm Park Mansions, Chelsea, S.W., gentleman; W. Eacott, 29, Powell Road, Clapton, N.E., gentleman; C. T. Lissenden, 24, Arico Road, Brockley, S.E., gentleman; W. J. McNelly, 25, Walter Street, Stepney, E., gentleman; and R. Bott, 36, Southcote Road, Woodside, South Norwood, S.E., gentleman. No initial public issue. The number of directors is not to be less than three or more than five; the subscribers are to appoint the first; qualification, one share; remuneration (except salaried managing director), £25 each per annum (chairman, £50). Registered office, Queen Anne's Chambers, Westminster.

Nilmelior (England), Ltd. (94,441).—This company was registered on August 1st, with a capital of £5,000 in £1 shares, to acquire the sole agency for the British Empire for the sale of accumulators, magnetos, contact coils and other articles for the ignition of explosive engines and accessories thereto, and other goods manufactured by Société d'Electricite "Nilmelior" (formerly Basee et Michel), of Paris, and to carry on the business of dealers in electrical goods and appliances of all kinds. The first subscribers (each with one share) are:—J. B. Sarel, 11, Pancras Lane, E.C., clerk; H. T. Page, 10, Daubeney Road, Clapton, N., clerk; W. F. Dyer, 11, Pancras Lane, E.C., clerk; H. W. Higgins, 11, Pancras Lane, E.C., clerk; C. Impey, 3, Eaton Terrace, St. John's Wood, clerk; P. C. Page, 58, Eswyn Road, Upper Tooting, clerk; and J. E. Friend, 51, High Street, Marylebone, clerk. No initial public issue. The number of directors is not to be less than three or more than six; the first are A. Michael, R. Schoeller, W. R. Elderfield and W. H. White.

Rapid Light Controlling Syndicate, Ltd. (94,461).—This company was registered on August 2nd, with a capital of £10,000 in £1 shares, to adopt an agreement with H. Sparks and E. Sparks, and to carry on the business of engineers, founders, smiths, machinists, manufacturers and patentees of, and dealers in, apparatus required for and capable of being used in connection with controlling artificial light. The first subscribers (each with one share) are:—J. Pettigrew, 11, St. Helen's Place, E.C., chemist; E. R. Tasman, 11, St. Helen's Place, E.C., merchant; J. C. Morgan, 6, St. Helen's Place, E.C., secretary; W. C. Greenop, 19, Cullum Street, E.C., solicitor; S. Cockerill, 11, St. Helen's Place, E.C., secretary; H. Sparks, Steam Works, Hughenden Road, Hastings, engineer; and E. Sparks, Steam Works, Hughenden Road, Hastings, engineer. Registered without articles of association.

British Automobile Improvements, Ltd. (94,477).—This company was registered on August 3rd, with a capital of £10,000 in £1 shares (5,000 10 per cent. cumulative preference) to carry on the business indicated by the title, and to adopt an agreement—(1) with S. Alley, and (2) with La Société des Apparils Electriques Ignes. The first subscribers (each with one share are:—J. M. Pye-Smith, 165, Fenchurch Street, E.C., merchant; V. Elkington, St. Aubyns, Woodborough Road, civil engineer; G. G. Harris, 2, Tor Gardens, Kensington, solicitor; H. B. Elkington, St. Aubyns, Woodborough Road, Putney, S.W., architect; J. R. Gask, 52, Brightside Road, Hither Green, S.E., clerk; H. J. Graham, 4, Newstead Road, Lee, S.E., solicitor; and E. E. Lucas, 58, Ivy Road, Cricklewood, clerk. No initial public issue. The first directors are to be appointed by the subscribers; qualification, 250 shares; remuneration, £100 each in any year when 10 per cent. is paid on the ordinary shares.

J. Crawford & Sons, Ltd. (94,514).—This company was registered on August 8th, with a capital of £2,500 in £10 shares, to acquire the business carried on by the executors of the late J. W. Hedley at Bonner's Field Engine Works, Sunderland, as J. Crawford & Sons, to adopt an agreement between Mary A. Thompson and Margaret E. Bushell (executors of the said J. W. Hedley) of the first part, J. Scorer of the second part, and the company of the third part, and to carry on the business of electrical, mechanical and consulting engineers, manufacturers of hauling engines, electric haulage plant, engines for dynamo driving, and machinery of all kinds, &c. The first subscribers (each with one share) are:—J. Scorer, 8, Woodlands, Hexham, engineer; A. Duncan, Sunderland, printer; J. R. Storey, 62, John Street, Sunderland, solicitor; L. Duncan, 22, Otto Terrace, Sunderland, shipowner; J. English, Broomfield, Chopwell, Ebchester, mining engineer; F. O. Kirkup, Beda Lodge, Rowlands Gill, mining engineer; and J. E. Parker, 62, John Street, Sunderland, chartered accountant. No initial public issue; J. Scorer is manager. Registered office, Bonner's Field Engine Works, Monkwearmouth, Sunderland.

Société Anonyme des Accumulateurs A.C.S. (Système de Sedneff), Ltd. (94,508).—This company was registered on August 7th, with a capital of £140,000 in £4 shares, to adopt an agreement between Cesar Trouin and Sigismond de Szepczynski of the one part and this company of the other part, to undertake and execute contracts for works involving the use of machinery and supply thereof in connection with the use of electricity, and to carry on the business of manufacturers of electric accumulators, electrical plant and accessories thereto, engineers, &c. The first subscribers (each with one share) are:—A. J. Lippens, 792, Salisbury House, E.C., accountant; F. G. Coake, 2, Radcot Street, Kennington, S.E., cashier; W. Brewer, 7, Frampton Park Road, South Hackney, N.E., clerk; T. W. Clementson, 62, Coventry Road, Ilford, printer; W. Welton, 8, Glencoe Avenue, Seven Kings, manager; A. N. Andrews, 88, Bishopsgate Street, E.C., cashier; and P. C. Andrews, 792, Salisbury House, E.C., secretary. Minimum cash subscription, £4,000. The number of directors is not to be less than two or more than seven; the first are to be appointed by the agreement or by the subscribers; qualification, 100 shares; remuneration, 10 per cent. of the profits available for dividend after 5 per cent. has been paid. Registered office, 790-792, Salisbury House, E.C.

CITY NOTES.

Metropolitan District Railway Co.

THE report of the directors for the half-year ended June 30th, 1907, which was read before the half-yearly meeting held on Wednesday, states that the expenditure on capital account during the half-year was £137,581; the gross receipts amounted to £220,628, being a decrease of £427. The working expenses amount to £143,936, a decrease of £22,976. After providing for rent charges, interest on debenture stock, and other charges, the net revenue account showed a deficit of £18,035, to which is added £10,156, being the company's proportion of net revenue arising from the City lines joint undertaking, which, although included in the net revenue account, is not available for payment of debenture interest, being specially appropriated to the payment of dividend on the 4 per cent. guaranteed stock. With the above-mentioned addition, the deficiency for the half-year chargeable to capital under the company's statutory powers is £28,192. The dividend payable on

the 4 per cent. guaranteed stock is at the rate of £1 12s. 6d. per cent. per annum. The following table shows the working expenditure in comparison with the corresponding period of last year:—

	Half-year ended June 30th. 1907.	Half-year ended June 30th, 1906.	Decrease.
Maintenance of way and works ..	£23,728	£24,135	£407
Maintenance of rolling stock ..	21,190	23,644	2,454
Train working and traffic expenses (including joint stations), after deducting the balance of accounts for work done for and by other companies	66,414	83,894	17,480
Rates and taxes (including joint stations)..	20,434	20,000	Inc. 434
Other items	12,170	15,239	3,069
Total	£143,936	£166,912	£22,976 = 13·77 %

The following table gives a summary of comparative figures for the first halves of the years 1906 and 1907:—

	Half-year ended June 30th, 1907.	Half-year ended June 30th, 1906.	Decrease.	Or per cent.
Passengers (including workmen and season tickets)	25,426,825	29,273,297	3,846,472	13·14
Passengers carried at workmen's fares	4,683,100	6,653,778	1,970,678	29·62
Passenger receipts	£202,099	£204,028	£1,929	·95
Average receipt per passenger ..	1·91d.	1·67d.	Inc. ·24d.	14·37
Train-mileage on District ..	1,178,743	1,199,569	20,826	1·74
Car-mileage on District	5,248,529	5,688,514	439,985	7·73

In consequence of the pressure of other business, Mr. R. W. Perks, M.P., has resigned his seat on the board.

Dublin United Tramways Co., Ltd.

At the recent half-yearly meeting, Mr. Wm. M. Murphy, the chairman, said that the gross receipts showed an increase of £10,328, while the increase of expenditure, excluding the cost of re-construction of the Dalkey line and altering the centre poles, was £7,365. The receipts constituted a record for the first half of the year. The board attribute this satisfactory result to the International Exhibition at Herbert Park. The months of May and June were so inclement and unseasonable, that without the help of the Exhibition they would scarcely have held their own, and he noticed that few tramway companies showed any increase for the half-year. The average consumption of electricity per car-mile had increased in a marked degree owing to the heavier cars in use and the higher rates of speed. These conditions accounted for an additional consumption of 911,848 units, an increase of 20 per cent., although the car-mileage increased only 4 per cent. But though coal cost an average of 5d. per ton more than in the corresponding half-year, the cost of generation per unit was actually less, being ·357 of a penny, against ·375 of a penny last year. The total cost of generating nearly a million additional units amounted to only £885, not quite a farthing per unit, and the cost of electric current generation per mile for operating the cars, notwithstanding their increased weight, still averaged less than one halfpenny per mile. This spoke well for the continued efficiency of their generating plant, which produced the whole of the electric supply during the past half-year at a shade over one-third of a penny per unit. They had had to consider the power available at the Ringsend generating station, for though the plant originally installed had been able to meet all demands up to the present, on some recent occasions the margin of reserve power was below a safe limit. A good margin of power to be available under any possible circumstances in case of a breakdown of one or more machines, was recognised as necessary in electrical stations on which the public was dependent for light, power, or locomotion. They determined, at any rate, to run no risks and had, therefore, recently installed a turbine generating set of 1,000 kw. That machine gave double the power of any of the existing generators, and increased the effective capacity of the station by one-third.

Liverpool Overhead Railway Co.

The half-yearly meeting was held on Tuesday, at Liverpool, Sir Wm. Forwood, presiding.

The Chairman, in moving the adoption of the report (see Electrical Review, August 9th, p. 232), said it contained some features which were more encouraging than those they had lately placed before the shareholders. Although the number of passengers carried on the railway during the half-year were 39,829 fewer than during the same period last year, the revenue had increased by £447, which was due to the increased value per passenger; this had gone up from 1·74d. to 1·78d. In the half-year ending December, 1899, when the company paid a dividend of 5 per cent. upon its ordinary shares, the value per passenger was 1·93d. If they had the same value and passengers now the revenue last half-year would have shown an increase of £2,684. To meet the serious competition which had been forced upon the company by the Liverpool Corporation tramways, and the electrification of the Lancashire and Yorkshire Railway, considerable reductions in the fares were urged as the only way of maintaining the hold upon their traffic. The directors were not wholly in sympathy with this policy, as they felt that there were peculiar conditions attaching to the railway which would prevent low fares proving an important inducement to additional travel. These views had proved to be in the main correct. Their low fares did not attract traffic to any great extent. The directors, therefore, adopted a middle course, and tentatively lowered their fares to competitive points, where they thought they might attract passengers. In this way they had only been partially successful, and during the half-year they had advanced some of the fares, with the good result he had indicated. A comparative view during the past five years showed clearly, he thought, that they had now mainly to rely upon their dock-side traffic. That was not inconsiderable, as during the past year they had carried 8,636,000 passengers, and they must now try and see if this traffic could not be maintained at fares such as would give some return upon their capital. In London, underground railways, twopenny tubes, motor-buses and tramways had all been forced to the conclusion that the policy of penny fares could be carried too far, and the fares for locomotion throughout London were now in process of revision. Their revenue per train-mile worked out at 20·26d., as against 20·09d. last year, and compared with the City and South London 33·66d., Central London Railway 61·89d. and the Mersey Railway 27·41d. There was a slight reduction in working expenses. These worked out at 16·09d. per train-mile, as against 16·28d. last year, and if they eliminated their renewal and contingent fund the figures would be 15·41d. per train-mile, against 15·66d. last year; while if they took into consideration that they had 17 stations on 6½ miles of railway, and that their structure was a costly one to maintain, he thought they could claim that their running expenses were lower than on any other electric line. On the City and South London Railway they were 14·94d. per train-mile; Central London, 33·71d.; and Mersey Railway, 20·38d. A satisfactory feature was the saving they had been able to effect in their rates. They appealed against their assessment, basing their case on a recent legal decision. The result was they had already effected a saving of £600 per annum, and expected to make a further saving of £1,500 per annum during the next year. During the current half-year they would have to pay a higher price for coal, which they hoped to minimise by alterations they had already made in their condensing plant and they had also under consideration the adoption of induced draught with a view to effecting a further economy in fuel. On July 1st an experimental system of residential contracts was introduced, and on August 1st the system was further extended by including an additional station or stations for an extra payment. The directors would watch their experiment with interest. The contracts were only being issued for six months, and should the system prove unremunerative it would be put an end to.

In seconding a vote of thanks, Mr. R. Sing remarked that the only feature which caused him anxiety was the position of the company's debenture debt. In 1913 the whole of the debenture debt fell due for payment. If they looked at the prices quoted on the Stock Exchange, it would be seen that recent sales were at a very low price—he believed as low as 84—though absolute redemption was in view at 100. It might be possible to make out of profits some provision so that the debenture debt could be handled more easily than seemed at present likely in 1913. If the debentures had to be renewed this year, at least 5 per cent. would have to be offered, and that would mean a serious depreciation both of the preference and the ordinary shares.

Chatham and District Light Railways Co.—The directors' report for the half-year ended June 30th, 1907, shows that the receipts were £18,273 and the expenses £12,941, leaving £5,332, less £222, amount written off as per revenue account, and £1,196 for interest on debentures. Adding the balance brought forward (£579), there is a balance of £4,493, which is to be carried forward. The Rochester Corporation are proceeding with their extension lines to Strood Hill, Frindsbury and Borstal, and it is anticipated that these will be completed early next year and leased to the company. No provision for depreciation has been made in these accounts. The directors propose to deal with this matter and the payment of dividends when the final accounts are made up at the end of the year.

Lanarkshire Tramways Co.—The report for the half-year ended June 30th, 1907, shows the following result:—Receipts £29,703, expenses £16,052; total £13,652. Less contributions payable to local authorities £621 10s., interest on debentures £608, interest on loans £224; total £12,199. Add balance brought forward £883, leaving a balance of £13,081. The directors propose that £7,899 be applied to dividend at the rate of 5½ per cent. per annum for the half-year, £5,183 being carried to revenue new account. A quotation was granted in February for the shares on the London Stock Exchange. No provision for depreciation has been made in these accounts; the directors, as usual, propose to deal with this matter when the final accounts are made up at the end of the year.

W. T. Henley's Telegraph Works Co., Ltd.—The directors have declared an interim dividend on the preference shares of 4½ per cent. per annum, less income-tax, and on the ordinary shares of 10 per cent. per annum, less income-tax, for the half-year ending June 30th last, both payable September 2nd. Last year for the corresponding period the dividend on the ordinary shares was at the same rate.

Friswell (1906), Ltd.—The directors' report of this automobile engineering company for the year ended June 30th recommends a dividend at the rate of 10 per cent. on the ordinary shares, carrying forward £366. There is an increase of more than £28,000 in sales as compared with the corresponding period of last year.

Belgium.—La Société Belge pour la Fabrication des Cables et Fils Electriques, of Brussels, is increasing its capital to £20,000.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Fortnight ended.	Receipts for the fortnight. £	Receipts for the fortnight. £*	No. of wks.	Total to date. £	Total to date. £*	Route miles open.	Inc.
Aberdeen	Aug. 7	3,109	— 22	10	15,809	— 48	14·4	..
Ayr	„ 10	869	— 64	13	5,119	— 218	5	..
Bath	„ 7	2,305	— 295	32	24,870	— 736	13	..
†Belfast	„ 9	3,639	— 40	18	66,452	+ 4,198	40	..
Birkenhead	„ 11	2,506	+ 151	19	20,313	— 371	18·52	..
Birmingham Corp.	„ 10	12,980	..	19	114,591	..	56·45	..
†Blackburn	July 31	1,106	+ 9	18½	20,489	+ 777	14·12	..
Blackpool Corp.	Aug. 8	5,351	— 255	..	28,841	— 1,714	11·87	..
„ —Fleetw'd.	„ 10	3,798	— 849	5	7,973	— 680	8·26	..
Bolton	„ 11	5,524	+1,142	19	44,359	+ 2,597	26	..
Bournemouth	„ 7	4,961	+ 377	18½	32,726	+ 551	21·5	2½
Bradford	„ 10	10,194	— 124	19	89,957	+ 234	53	..
Brighton	„ 11	2,961	— 553	19	18,427	— 2,059	9·5	..
Bristol	„ 9	12,196	— 269	..	..	..	28·5	..
Brit. Elec. Trac. Co.								
Airdrie	„ 2	380	— 28	30	6,700	— 7	3·65	..
Barnsley	„ 2	343	+ 12	„	4,920	+ 6	..	..
Barrow	„ 2	658	— 18	„	7,547	— 81	5·37	..
Cavehill	„ 2	227	— 41	„	2,588	+ 66	..	..
Devonport	„ 2	955	— 74	„	18,699	— 68	8·85	..
Gateshead	„ 2	2,061	— 15	„	30,236	+ 600	11·25	..
Gravesend	„ 2	542	— 17	„	7,189	— 15	6·5	..
Greenock	„ 2	1,430	— 99	„	20,069	— 118	7·25	..
Hartlepool	„ 2	698	— 78	„	8,487	— 516	6·72	..
Kidderminster	„ 2	289	— 1	„	3,413	— 161	..	..
Leamington	„ 2	363	— 59	„	4,640	— 739	3	..
Merthyr	„ 2	408	— 6	„	6,251	+ 309	2·9	..
‡Metropolitan	„ 2	10,806	+2,770	„	134,599	+29,125	22	..
Middleton	„ 2	828	+ 4	„	10,559	— 196	8·5	..
Mid. Joint Com'tee	„ 2	11,650	..	„	172,680	..	..	..
Oldham — Ashton	„ 2	1,284	+ 60	„	18,082	+ 226	9·13	..
Peterborough	„ 2	276	— 44	„	3,676	— 168	5·31	..
Potteries	„ 2	3,809	+ 72	„	56,489	+ 1,414	29	..
Rothesay	„ 2	1,160	— 83	„	6,151	— 337	2·75	..
Southport	„ 2	771	— 16	„	8,651	— 533	8·17	..
S. Metropolitan	„ 2	1,807	+ 778	„	23,028	..	..	..
Swansea	„ 2	2,020	+ 124	„	25,889	+ 917	5·5	..
Tynemouth	„ 2	808	— 70	„	6,935	— 737	3·75	..
Weston-s-Mare	July 31	610	— 65	„	3,287	— 425	3	..
‡Worcester	Aug. 2	661	— 30	„	8,295	— 247	5·75	..
Wrexham	„ 2	224	+ 2	„	3,080	— 35	..	..
Yorks. Wool. Dist.	„ 2	2,169	+ 31	„	28,894	+ 1,338	17	..
Miscellaneous	„ 2	512	..	„	6,583	..	..	..
Burnley	„ 10	2,782	+ 116	..	..	..	7·5	..
Burton-on-Trent	„ 11	688	— 50	19	5,667	— 302	6·7	1·5
Bury	„ 4	2,305	..	18	19,229	..	10·5	..
Cardiff	„ 10	4,981	— 225	19	43,023	+ 2,046	15·87	..
Carlisle	„ 10	413	— 43	92	5,476	— 402	..	..
Chatham and Dist.	„ 8	1,694	+ 191	32	22,701	+ 1,954	12·84	2·55
Cork	„ 8	1,064	— 99	32	14,690	— 549	9·89	..
Croydon	„ 9	3,351	— 185	19	27,803	— 1,749	12	·75
†Darlington	„ 10	236	+ 2	19	4,082	— 35	..	..
†Darwen	„ 9	501	— 33	19	4,858	— 18	4·36	..
Dover	„ 10	633	— 143	19	4,873	— 698	4·75	..
Dublin	„ 9	15,658	+3,397	28	43,080	+10,137	54·25	5·5
Dundee	„ 7	2,502	— 104	12	13,795	+ 289	13	·5
East Ham	„ 10	2,691	— 15	19	17,765	— 416	7·75	..
†Exeter	„ 9	446	+ 8	19	6,291	+ 551	4·75	·5
Glasgow	„ 10	34,122	+ 530	10	175,031	+ 2,014	89·75	8·5
Hastings	„ 8	3,370	..	..	..	..	..	..
Huddersfield	„ 10	3,706	+ 200	19	20,583	+ 1,209	28	..
Hull	„ 10	5,149	+ 189	19	45,610	+ 2,138	13	..
Ilkeston	„ 7	343	— 5	19	2,765	+ 168	3·5	..
Ipswich	„ 10	1,140	— 102	19	8,102	— 681	10·5	..
Isle of Thanet	„ 10	3,423	— 208	32	17,762	— 813	11	..
Kilmarnock	„ 10	822	— 27	12	2,197	— 82	4·19	..
Lan'kshire Trm. Co.	„ 8	2 411	+ 667	32	35,476	+ 8,803	15·22	3·26
Lancashire United	„ 7	3,150	+ 650	32	39,462	+10,229	38·5	9
Leeds	„ 10	15,097	+1,065	19	120,501	+ 4,982	51·12	6·5
Leicester	„ 10	5,151	— 66	..	..	..	..	..
†Leith	„ 10	552	+ 6	12½	7,097	+ 71	6	..
Liverpool	„ 3	23,254	+ 502	31	333,844	+ 4,750	104	..
‡L.C.C.	„ 3	52,705	+10,300	19	561,389	+86,580	117½	23·37
London United	„ 9	18,228	+1,077	31½	208,850	+ 5,787	..	..
Lowestoft	„ 10	983	— 7	45	8,160	+ 908	3·5	..
Manchester	„ 10	31,282	+1,384	19	282,348	+21,411	172	20
Newcastle	„ 10	8 370	+ 149	19	79,530	+ 448	..	..
Newport	„ 10	1,594	+ 24	19	13,966	+ 1,575	14·5	..
Northampton	„ 9	1,114	— 72	18½	8,498	— 429	5·5	..
Oldham	„ 11	4,067	+ 182	20	38,974	+ 2,580	23·75	..
Pontypridd	„ 10	585	+ 201	19	5,111	+ 1,807	5	1·75
Portsmouth	„ 10	5,502	— 386	19	39,526	— 2,010	14·5	..
Preston	„ 7	1,596	— 49	..	..	..	..	..
Reading	„ 8	1,474	— 114	18½	11,791	— 571	13·25	..
Rotherham	„ 8	1,345	+ 174	18½	11,196	+ 1,633	10	·67
Salford	„ 12	9,715	+ 184	19	90,512	+ 1,812	38·9	..
Sheffield	„ 11	11,685	+ 474	20	111 291	+ 4,794	35·75	..
Southampton	„ 7	2,613	+ 145	18½	19,919	+ 522	..	..
Southend-on-Sea	„ 7	1,461	— 9	19	7 815	— 963	..	..
Sunderland	„ 4	1,560	— 132	18	26.044	— 272	..	..
†Swindon	„ 17	154	+ 6	..	..	..	4·4	..
Tyneside	„ 7	1,664	— 46	32	14 804	+ 617	8·27	..
Wallasey	„ 10	2.292	+ 107	18	16,718	+ 844	8·72	·05
Walthamstow	„ 10	1,624	— 21	19	12.329	— 194	9	..
West Ham	„ 8	5 188	+ 120	19	45,675	+ 1,246	14·7	..
Wolverhampton	„ 7	1,975	+ 12	18	16,430	+ 267	20	..
Yorks. W. Riding	„ 11	2,911	+ 681	32	26.528	..	..	..
Baker St.-Waterloo	„ 10	4 885	+1,885	6	14,580	+ 6,541	4·25	1
Cen. London Rly.	„ 10	9 095	— 970	6	20 886	— 2,555	6	..
†Char. +, Eus. Hmp.	„ 10	5,330	..	6	15,775	..	7·75	..
City & S. Lon. Rly.	„ 11	6.010	+1,462	6	18.757	+ 4,072	7 3	1
Dublin-Lucan Rly.	„ 9	860	+ 25	6	908	+ 87	7	..
G.N. and City Rly.	„ 10	2,997	+ 49	6	9,758	+ 176	3·5	..
G.N., P'dy. & Brmp.	„ 10	7,470	..	6	24,560	..	9	..
L'pool Overh'd Rly.	„ 11	8,875	+ 457	6	10,650	+ 1,009	6·8	4·8
Mersey Railway	„ 10	5,757	+ 240	6	11 105	+ 966	4·5	..
Metropolitan Rly.	„ 11	28,259	+ 687	6	90.749	+ 8,090	24·5	..
Met. District Rly.	„ 11	14.047	+ 272	6	45,645	+ 281	24	..
Anglo-Argentine	„ 12	33,141	+2,865	32	557.288	+54,353	48	..
‡Auckland	July 19	10,178	+ 849	28½	78,706	+ 2,968	19·2	·56
‡Brisbane	„	12,775	+1,617	..	..	..	..	..
‡Brit. Columbia Rly.	June	97.211	+8,743	52	908,574	+64,722	..	..
Calcutta	Aug. 10	6,271	+ 540	..	..	..	..	..
‡Cape Electric T. Ld.	May	12,710	..	..	..	..	..	..
‡Geneva	June	3.840	+ 435	..	..	..	..	..
‡Kalgoorlie, W.A.	July	3,554	..	30	27,406	..	20·5	..
Madras	„ 31	1,197	+ 212	30	15,911	+ 2,614	12·75	2·25
‡Lisbon	May	996	..	..	..	..	..	..
Perth (W.A.)	Aug. 9	2,670	— 66	32	45,609	— 1,545	25·5	·4

* Compared with the corresponding period of 1906. † One week only.
‡ Includes horse, steam and other receipts § One month.

STOCKS AND SHARES.

Tuesday Afternoon.

Every market in the Stock Exchange has fallen beneath the evil influences of the slump in Consols and Americans. The former has demoralised investment securities: the latter has upset investment and speculative divisions alike. As usual, the losses incurred in connection with speculation have had to be met by forced sales of stock in other departments, which departments, already agitated by the drop in the Funds, were in no mood to have fresh stock thrust upon them when buyers were conspicuous by not being there. To this reason, broadly speaking, must be attributed the declines in most investment issues, and that electrical varieties have so far managed to escape very lightly in the general malaise is evidence, partly of inherent strength, partly of lack of market in most of them.

Charing Cross shares have altogether failed to benefit from the issue of a report which reads satisfactorily enough as showing useful increases in revenue received and current supplied. Edmundson's Preference hardened slightly to 1⅞, while Urbans keep stationary. The chief movement is a 10s. fall in Notting Hill shares, reducing the price to 11½. Newcastle-on-Tyne Ordinary are flatter, and the Preference at 5—5½ are a trifle down. The Brush group is unaltered.

After being down to 39, Metropolitan Consolidated rallied to 40¼, still 1 lower on the week. Districts at 11½ excite no interest in the minds of any but hapless proprietors. The Home Railway market has been in a deplorable condition, every day bringing forth fresh processions of declines. On Monday, however, something of a recovery set in amongst the speculative stocks. City and South London continues dullish at 46, and Central London Preferred lost a point at 92.

For such shares as British Electric Traction Ordinary and Preference to have fallen ½ is not perhaps very surprising. Traction issues are dull on the whole, and Anglo-Argentine Ordinary at 8⅜ are ½ easier. When the rearrangement of this company's capital was first announced last month, a little speculative buying ensued, and the purchasers, finding that the price has not responded in accordance with their anticipations, are now quietly getting out of the shares. Belgranos keep pretty firm.

Telegraph stocks are one of the few good markets round the Stock Exchange. Prices are certainly not much better, but the falls have been limited. Anglo-Americans, of course, gave way again on the Yankee scare. The Deferred stock has fallen a further ½ to 17⅛, after going appreciably lower. The Preferred stock lost 2 points, and the Ordinary 1. The 6 per cent. Preferred is down to 106¼, paying over 5⅔ per cent. on the money, dividends being distributed quarterly. Western Telegraphs at 13¼ are down another 10s., there being a few shares on tap, while the strike of telegraphists in New York proved a source of uneasiness. Eastern Extensions at 13¼ have shed ⅛, although Eastern Telegraph Ordinary at 13⅝ has been left unchanged. One or two Debenture stocks have actually improved, but Globe Telegraph and Trust Ordinary at 10⅜ are not quite so steady.

National Telephone Preferred gave way ½, while Chili Telephone shares at 7 have replaced their fall of a week ago.

The leopard will have to change his spots before Henley's Telegraph Works are likely to alter the dividend, and the declaration of the customary rate has left the price of the Ordinary at 12 middle. Callenders at 10¼ are the fraction better. India-Rubber shares came on offer, and the price was accordingly reduced 10s. to 15s. In the Engineering group, Babcock & Wilcox at 3⅞ have slightly receded, but these movements are to be explained by the necessity already mentioned, for providing funds wherewith to meet differences incurred over speculative commitments. Willans and Robinsons keep their quotations, and Crompton 5 per cent. First Mortgage Debentures at 95½ are ½ higher.

Charing Cross, West End and City Electricity Supply Co., Ltd.—As briefly announced last week, the directors have declared an interim dividend at the rate of 5 per cent. per annum on the ordinary shares of the West End undertaking. The figures for the half-year ended June 30th, 1907, as compared with the corresponding period of last year (excluding the bulk supply from one undertaking to the other), are:—

	1907.	1906.
West End.		
Units sold	5,098,880	4,720,221
Revenue	£63,561	£60,564
City.		
Units sold	4,234,989	3,497,830
Revenue	£44,583	£38,228

Anglo-Argentine Tramways Co., Ltd.—At a special meeting held on the 12th inst., the resolutions passed on July 26th, for acquiring the Buenos Ayres and Belgrano tramways, were confirmed.

Alteration of Bank Rate.—The Bank Rate has been raised to 4½ per cent.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. *	Dividends for the last four years. 1903.	1904.	1905.	1906.	Closing Quotations Aug. 6th.	Closing Quotations Aug. 13th.	Business done week ended Aug. 18th, 1907. Highest.	Lowest.	Rise + or Fall —	Present Yield per cent. £ s. d.
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	..	3 — 3½	3 — 3½	..	..	..	Nil
149,600	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	Nil	Nil	5 %	5 %	85 — 88	85 — 88	..	..	..	5 13 8
660,660	Anglo-American Telegraph	Stock	61s.	28%	31%	32%	61 — 64 xd	60 — 63	62	60	—1	6 3 0
3,169,670	Do. do. do. 6 % Pref.	Stock	6 %	5%	6 %	6 %	107½—108½ xd	105½—106½	108	105½	—1½	5 12 5
3,169,670	Do. do. do. Deferred ..	Stock	2s.	Nil	1%	13%	17⅞— 17⅞	16⅞— 17½	17⅞	16½	— ⅛	10 2 11
50,000	Anglo-Portuguese Tel., 5 % Mort. Deb. Stock Red.	100	..	..	5 %	5 %	101 —104	101 —104	..	..	..	4 16 2
44,000	Chili Telephone, Nos. 1 to 44,000	5	7 %	8 %	8 %	8 %	6⅞— 7⅛	6⅞— 7⅛ xd	..	..	+ ⅛	5 10 4
2,097,680	Commercial Cable Stng. 500 year 4 % Deb. Sk. Red.	Stock	4 %	4 %	4 %	4 %	92 — 94	92 — 94	93½	..	..	4 5 1
16,000	Cuba Telegraph	10	0 %	5 %	5 %	5 %	7½— 8½	7½— 8½	..	..	..	6 1 3
6,000	Do. 10 % Pref.	10	15 %	10 %	10 %	10 %	15½— 16½	15½— 16½	..	..	..	5 19 5
12,931	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	4 %	3⅜— 3⅝	3⅜— 3⅝	..	..	..	5 8 6
6,000	Do. do. 10 % Cum. Pref. ..	5	10 %	10 %	10 %	10 %	9 — 9½ xd	9 — 9½	..	..	..	5 5 3
30,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	98 —101	98 —101 xd	..	..	..	4 9 1
60,710‡	Direct United States Cable	20	3 %	3¼%	4½%	4⅝%	15⅛— 15⅝ xd and bonus	15½— 15⅝	15 7/16	15⅛	..	6 15 9
57,000	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,200, R.	100	4½%	4½%	4½%	4½%	99 —101	99½—101½	..	..	+ ½	4 8 8
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	7 %	134 —139	134 —139	136½	124½	..	5 0 9
2,000,000	Do. 3½ % Pref. Stock	100	3½%	3½%	3½%	3½%	88 — 90	88 — 90	88½	88½	..	3 17 9
1,896,706	Do. 4 % Mort. Deb. Stock. Red. ..	Stock	4 %	4 %	4 %	4 %	103 —105	103 —105	104¼	..	..	3 16 2
300,000	Eastern Extension, Australasia, and China Tele.	10	7 %	7 %	7 %	7 %	13¼— 13⅝	13 — 13½	13⅝	13½	— ⅛	5 3 8
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	102 —104 xd	102 —104	103¼	..	..	3 16 11
295,400	East & S. Afric. Tel., 4 % Mt. Db., 1 to 3,900, red. 1909	100	4 %	4 %	4 %	4 %	97½—100½ xd	97½—100½	..	..	..	3 19 7
200,000‡	Do. 4 % Reg. M. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	98¾—100¾	98¾—100¾	..	..	..	3 19 7
181,127	Globe Telegraph and Trust	10	5½%	5⅝%	5½%	5½%	10½— 11½	10½— 11	10⅜	10⅛	— ½	5 0 0
181,127	Do. do. 6 % Pref.	10	6 %	6 %	6 %	6 %	13¾— 14	13¾— 14	13 13/32	13 11/32	..	4 5 9
150,000	Great Northern Telegraph, of Copenhagen	10	15 %	24 %	24%	20 %	34 — 36	34 — 36	34½	..	..	5 11 1
28,900	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	4½%	99 —101	99½—101½	..	..	+ ½	4 8 8
17,000	Indo-European Telegraph	25	10 %	13 %	13 %	13 %	56— 58	56 — 58	55½	..	..	5 19 1
$41,380,400	Mackay Companies Common	$100	..	1 %	2 %	3½%	66 — 68	66 — 68	..	..	..	5 2 11
$50,000,000	Do. do. 4% Cum. Pref.	$100	..	4 %	4 %	4 %	67 — 69	67 — 69	..	..	..	5 15 11
256,127	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	..	3/16— 3/8	3/16— 3/8	..	..	..	Nil
72,680	Monte Video Telephone Co., Ltd. Ord. ..	1	3 %	4 %	5 %	..	1 3/16— 1 5/16	1 3/16— 1 5/16	..	..	..	4 14 1
86,492	Do. do. do. 5 % Pref. ..	1	5 %	5 %	5 %	..	1/4— 5/16	5/16	..	..	..	5 0 0
2,225,800	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	106½ 108½ xd	106 —108	107	105½	— ½	5 11 1
2,225,000	Do. do. Def. Stock	100	5 %	5 %	5 %	5½%	105 —107 xd	105 —107	106½	105½	..	4 13 6
15,000	Do. do. 6 % Cum. 1st. Pref.	10	6 %	6 %	6 %	6 %	11 — 13 xd	11 — 13	11½	..	..	4 12 4
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	5 %	9½— 11½ xd	9½— 11½	10¼	..	..	4 6 11
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5 5/16— 5 7/16 xd	5 5/16— 5 7/16	5 7/16	..	..	4 9 11
2,000,000	Do. do. 3½ % Deb. Stock Red. ..	Stock	3½%	3½%	3½%	3½%	95¾— 97½	95¾— 97½	96⅜	96	..	3 1 6
1,689,593	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	100½—102½	100½—102½	102	..	..	3 18 1
179,313	Oriental Telep. and Elec. 1 to 171,504, fully paid ..	1	6¼%	6¼%	7 %	7 %	1½— 1⅝	1½— 1⅝	..	..	..	5 1 10
50,000	Do. do. do. 6 % Cum. Pref. ..	1	6 %	6 %	6 %	6 %	1 5/16— 1 7/16	1 5/16— 1 7/16	..	..	..	4 11 5
100,000	Do. do. do. 4 % Red. Deb. Stock ..	100	..	..	4 %	4 %	91 — 94	91 — 94	..	..	..	4 5 1
100,000	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	10	4 %	4 %	4 %	4 %	97 —100	97 —100	..	..	..	4 0 0
11,839‖	Reuter's	8	5 %	5 %	5 %	5 %	7 — 8	7 — 8	..	..	..	5 0 0
60,000	Telephone Co. of Egypt, 4½ % Deb. Red.	100	..	..	4½%	4½%	98 —101	98 —101	..	..	..	4 10 0
3,167	Submarine Cables Trust	Cert.	6 %	6 %	6 %	6 %	127 —130	127 —130	..	..	..	4 12 4
80,000	United River Plate Telephone	5	8 %	8 %	8 %	8 %	6½— 7⅛ xd	6½— 7⅛	..	..	..	5 10 4
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 %	5 — 5⅛	5 — 5⅛	..	..	..	4 10 11
15,60 l	West African Telegraph, Shares	10	4 %	4½%	4 %	4 %	10 — 10½	10 — 10½	..	..	..	3 16 3
30,008	W. Coast of America, 1 to 30,000 & 53,001 to 53,008	2	Nil	Nil	Nil	2½%	1⅛— 1⅜	1⅛— 1⅜	..	..	..	3 12 9
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	4 %	97 —100	97 —100	..	..	..	3 18 5
207,930	Western Telegraph, Ltd., Nos. 1 to 207,930.. ..	10	7 %	7 %	7 %	..	13½— 14	13 — 13½	13⅛	13⅜	— ⅛	5 3 8
800,000	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	100 —103	100 —103	..	..	..	3 17 8
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	Nil	7/16— 9/16	7/16— 9/16	8/9	..	..	Nil
34,563	Do. do. 6 % Cum. 1st Pref.	10	7 %†	6 %	5 %	8 %	7½— 7¾	7½— 7¾	7½	..	..	10 5 9
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	Nil	Nil	6½— 7½	6½— 7½	..	..	+ ½	Nil
0,000‡	Do. do. 5 % Debs., Nos. 1 to 1,800 ..	100	5 %	5 %	5 %	5 %	99 —102	99 —102	..	..	..	4 18 0

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

270,000	Anglo-Argentine Trams, Nos. 260,008 to 510,007, and 560,008 to 580,007	5	..	8 %	8 %	8 %	8⅜— 8⅝	8½— 8½	8½	8¼	— ⅛	4 14 1
260,007	Do. 5½ % Cum. Prefs., 1 to 260,007 ..	5	5½%	5½%	5½%	5½%	6 — 6½	6 — 6½	6 3/16	..	..	4 8 0
266,600	Do. Permanent, 6 % Deb. Stock, 1888	100	6 %	6 %	6 %	6 %	131 —134	131 —134	131	..	..	4 9 7
285,100	Auckland E. Trams, 5 % 1st Mort. Deb. Stock ..	100	5 %	5 %	5 %	5 %	102 —105	102 —105	..	..	..	4 15 8
880,000	Babcock & Wilcox, 1 to 880,000	1	17 %	20 %	20 %	20 %	3⅞— 4⅛	3⅞— 4	78/9	77/6	— ⅛	5 0 0
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	6 %	6 %	6 %	6 %	1⅛— 1⅜	1⅛— 1⅜	..	..	..	3 7 7
38,000	British Aluminium, Ord., 2,001 to 40,000	5	..	7 %	7 %	7 %	4½— 5⅛	4½— 5⅛	5⅛	5 1/16	..	7 0 0
40,000	Do. do. 7 % Cum. Pref.	5	Nil	7 %	7 %	7 %	5 — 5⅛	5 — 5⅛	5 1/16	..	..	6 7 3
20,000	Do. do. "A" 6 % Cum. Pref.	5	Nil	6 %	6 %	6 %	5 — 5½	4⅝— 5½	..	..	— ½	5 14 3
20,000	Do. do. 4 % Funding Certs.	5	..	4 %	4 %	4 %	3½— 4½	3½— 4½	..	..	..	4 14 1
258,000	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	5 %	5 %	5 %	5 %	100 —103	100 —103	..	..	..	4 17 1
300,000	Do. do. 5½ % Loch Leven Debs. ..	100	..	..	..	5½%	96 — 99 xd	96 — 99	97½	..	..	5 11 1
400,000	British Columbia E. Rail Def. Ord. Stock ..	100	6 %	6 %	6 %	6 %	127 —132	127 —132	129	..	..	4 10 11
300,000	Do. 5 % Pref. Ord. Stock	100	5 %	5 %	5 %	5 %	110 —114	110 —114	112½	112	..	4 7 9
300,000	Do. 5 % Cum. Perp. Pref. Stock	100	5 %	5 %	5 %	5 %	103 —106	103 —106	101½	..	..	4 14 4
238,000	Do. 4½ % 1st Mort. Debs., 1 to 5,250	40	4½%	4½%	4½%	4½%	100 —103	100 —103	..	..	..	4 7 5
220,000	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	4½%	4½%	4½%	4½%	100 —102	100 —102	101⅝	..	..	4 8 3
133,301	British Electric Traction	10	6 %	6 %	3 %	Nil	2½— 3	2⅝— 2⅞	52/6	48/9	— ⅛	Nil
161,497	Do. do. 6 % Cum. Pref.	10	6 %	6 %	6 %	6 %	7 — 7⅛	6⅞— 7⅛	7⅛	6⅞	— ⅛	8 2 9
1,448,653	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	5 %	100 —103	100—103	101½	..	..	4 17 1
410,178	Do. do. 4½ % 2nd Deb. Stock Red.	100	..	4½%	4½%	4½%	78 — 81	78 — 81	..	..	..	5 11 1
100,000	British Insulated and Helsby Cables	5	8 %	8 %	8 %	10 %	6⅞— 7⅛	6⅞— 7⅛	7⅛	6 15/16	..	6 17 11
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	5⅝— 6⅛ xd	5⅝— 6⅛	..	..	..	4 18 0
500,000	Do. do. 4½ % 1st Mort. Deb. Red. ..	100	4½%	4½%	4½%	4½%	101 — 104	101 —104	102¼	..	..	4 6 7
212,000	British Thomson-Houston 4½ % 1st Mort. Debs.	100	4½%	4½%	4½%	4½%	87 — 91	87 — 91	..	..	..	4 18 11
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 475,000	5	6 %	Nil	Nil	..	1 — 1⅛	1 — 1⅛	24/-	23/1½	..	Nil
1,016,353	Do. do. 4 % Mort. Deb. Stock ..	100	4 %	4 %	4 %	4 %	59 — 64	59 — 64	..	..	..	6 5 0
50,000	†Browett, Lindley & Co., Ord.	£1	Nil	Nil	Nil	..	1 1/16— 1⅛	1 1/16— 1⅛	..	..	..	Nil
50,000	‡ Do. do. 6 % Cum. Pref.	£1	Nil	Nil	Nil	..	14/6 to 15/6	14/6 to 15/6	..	..	..	Nil
105,731	Brush Electrical Engineering, Ord., 1 to 105,731 ..	2	Nil	Nil	2½%	Nil	1/4— 3/8	1/4— 3/8	..	..	..	Nil
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	6 %	6 %	Nil	3/4— 1⅛	3/4— 1⅛	..	..	..	Nil
125,000‡	Do. do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	88 — 91	89 — 91	..	..	..	4 18 11
125,000‡	Do. do. 4½ % Perp. 2nd Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	71 — 74	71 — 74	..	..	..	6 1 7
100,000	Buenos Ayres & Belgrano, 1 to 100,000	5	3 %	4 %	3 %	3 %	4⅛ — 4⅜	4⅛ — 4⅜	85/7½	82/6	..	3 8 7
40,000	Do. do. "A" 6 % Cum. Pref., 1 to 40,000	5	6 %	6 %	6 %	6 %	4⅜— 5⅛	4⅜— 5⅛	..	..	..	5 14 3
27,500	Do. do. "B" do., 1 to 27,500	5	6 %	6 %	6 %	6 %	4⅛— 5⅛	4⅛— 5⅛	95/-	..	..	5 14 3
13,200	Do. do. 5 % Deb. Stock	100	5 %	5 %	5 %	5 %	105 —115	105 —115	..	..	..	4 6 11
190,000	Do. do. 5 % 2nd Deb. Stock	100	5 %	5 %	5 %	5 %	100 —103	100 —103	..	..	..	4 17 1
187,610	Calcutta Trams, 1 to 187,610	5	6 %	8 %	8 %	8 %	7⅛— 8	7⅛— 8	..	..	..	5 0 0
30,000	Do. 5 % Cum. Pref., Nos. 1 to 29,330..	5	..	..	5 %	5 %	5⅛— 5⅜	5⅛— 5⅜	..	..	..	4 8 11
350,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	102 —106	102 —106	102⅜	..	..	4 4 11
35,000	Callender's Cable Construction shares	5	12½%	12½%	15 %	15 %	9⅜— 10⅛	9⅜— 10⅜	..	..	+ ½	7 0 0
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	5⅜— 5⅝	5⅜— 5⅝	..	..	..	4 8 11
300,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	105¼—107½	105¼—107½	106½	106½	..	4 3 9
491,222	Cape E Trams., 1 to 491,222	1	10 %	5 %	Nil	..	3/16— 7/16	3/16— 7/16	..	..	..	Nil
450,000	Castner-Kellner Alkali, 1 to 450,000	1	4 %	4 %	6 %	8 %	1 5/16— 1 7/16	1 5/16— 1 7/16	..	..	..	6 1 11
224,988	Do. do. 4½ % 1st Mort. Deb. Stock	100	4½%	4½%	4½%	..	95 —100 xd	95 —100	..	..	..	4 8 3
911,568	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	4 %	73 — 75	73 — 75	74⅜	..	..	5 6 8
544,316	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	4 %	92 — 94	91 — 93	..	..	—1	4 6 0
544,316	Do. do. Def. do.	Stock	4 %	4 %	4 %	4 %	53 — 56	53 — 56	53½	..	..	7 2 10
1,480,000	City and South London Railway	Stock	2⅜%	2⅜%	1⅞%	2½%	45 — 47	45 — 47	46⅞	46⅝	..	4 10 5
85,000	Crompton & Co., Nos. 1 to 85,000	5	2½%	2½%	2½%	5 %	1⅞— 2⅛	1⅞— 2⅛	42/6	40/3	..	6 17 11
100,000‡	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	..	..	5 %	5 %	5 %	93¼— 95½	94 — 97	..	..	+ ½	5 3 1

* Unless otherwise stated, all shares are fully paid. † A period of nine months. ‡ From Manchester Share List.

(Continued on next page.)

SHARE LIST OF ELECTRICAL COMPANIES.—(*Continued.*)

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—(*Continued*)

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years.				Closing Quotations Aug. 6th.	Closing Quotations Aug. 13th.	Business done week ended Aug. 13th, 1907.		Rise + or Fall —	Present Yield per cent.
		*	1903.	1904.	1905.	1906.			Highest	Lowest.		£ s. d.
260,000	Dick, Kerr & Co., 1 to 260,000	1	..	10 %	10 %	..	1⅜ — 1⅝	1⅜ — 1⅝	..	..	..	6 3 1
305,000	Do. do. 6 % Cum. Pref., 1 to 305,000	1	6 %	6 %	6 %	..	1 — 1¼	1 — 1¼	..	..	..	4 16 0
294,150	Do. do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	101 —104	101 —104	..	..	..	4 6 7
60,000	Dublin United Trams. (1896), 1 to 60,000	10	5½%	6 %	6%	6 %	13¼ — 14¼ xd	13⅜ — 14⅜	..	..	..	4 7 8
59,987	Do. 6 % Pref. between 1 and 60,000	10	6 %	6 %	6 %	6 %	12⅞ — 13⅞ xd	12⅞ — 13⅞	..	..	..	4 7 8
99,261	Edison & Swan Utd., "A" shs., £3 pd., 1 to 99,261	5	N	2½%	4½%	..	1⅞ — 1⅞	1⅞ — 1⅞	..	..	..	9 1 10
17,139	Do. "A" shares, 01—017,139	5	N	2½%	4½%	..	2¼ — 2⅜	2¼ — 2⅜	..	..	..	8 6 9
319,475	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	83 — 85	83 — 85	..	..	..	4 14 2
72,220	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	89 — 92	89 — 92	..	..	..	5 8 8
112,100	Electric Contruction, 1 to 112,100	2	4 %	Nil	Nil	Nil	1/16 — 1/8	1/16 — 1/8	..	..	..	Nil
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390	2	7 %	7 %	7 %	Nil	1⅛ — 1⅜	1⅛ — 1⅜	..	..	..	Nil
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	4 %	5 %	5 %	5 %	8 — 8½	8 — 8½	..	..	..	5 17 8
200,000	Do. do 4 % Mort Deb.	Stock	4 %	4 %	4 %	4 %	92 — 95	92 — 95	..	..	..	5 16 8
78,000	Gt. N. & City Rail. Pref. Ord. "A" 4 %, 1 to 78,000	10	3 %	4 %	4 %	4 %	1⅞ — 2⅛	1⅞ — 2⅛	..	..	..	20 0 0
96,000	Greenwood & Batley, 7 % Cum. Pref.	10	7 %	7 %	7 %	7 %	10⅜ — 10⅝	10⅛ — 10⅜	..	..	..	6 13 4
80,000	Do. do. 5 % Mort. Debs.	100	5 %	5 %	5 %	5 %	102 —103	1 02 —103	..	..	..	4 17 1
200,000	Henley's (W. T.), Telegraph Works, Ord.	5	15 %	15 %	15%	15 %	11⅛ — 12⅛	11⅛ — 12⅛	11⅜	..	..	6 0 0
200,000	Do. do. 4½ % Pref.	5	4½%	4½%	4½%	4½%	5 — 5⅛	5 — 5⅛	5⅜	..	..	3 17 3
150,000	Do. do. 4½ % Mort. Deb. Stock	Stock	4½%	4½%	4½%	4½%	105¾—107⅛	105¾—107⅛	..	..	..	4 3 9
50,000	India-Rubber, Gutta-percha & Telegraph Works	10	10%	5 %	10%	10 %	15 — 16	14½ — 15½	15⅜	14 15/16	— ⅛	6 9 0
37,500	†Liverpool Overhead Railway, Ord.	10	1⅜%	1½%	Nil	Nil	1⅛ — 1⅜	1⅛ — 2	..	..	+ 3/16	Nil
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	5 %	6¼ — 7½	7 — 8	..	..	..	6 5 0
600,070	London United Trams. (1901), 1 to 50,007	10	8 %	6 %	3 %	3 %	6½ — 7⅛	6¼ — 7⅛	..	..	..	8 8 7
399,930	Do. do. 60,008 to 100,000	10	8 %	6 %	3 %	3 %	6¼ — 7⅛	6¼ — 7⅛	..	..	..	5 2 2
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	5 %	5 %	5 %	5 %	7⅛ — 8⅜	7⅛ — 8⅜ xd	..	..	..	5 14 8
1,331,000	Do. do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	84 — 88	84 — 88	84½	..	..	4 10 11
314,016	Metropolitan Electric Trams., Defd.	1	Nil	Nil	Nil	Nil	3/16 — 5/16	3/16 — 5/16	..	..	..	Nil
500,000	Do. do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	1/16 — 1/16xd	1/16 — 1/16	..	..	..	5 6 8
350,000	Do. do. 4½ % Deb. Stock Red.	100	..	4½%	4½%	4½%	94 — 97	94 — 97 xd	..	..	..	4 10 11
30,000	Peebles (B.) & Co., 6 % Cum. Pref., 20,001 to 50,000	5	..	6 %	6 %	6 %	3¾ — 4	3¾ — 4	..	..	..	7 10 0
245,500	Potteries E. Trc.	1	5 %	5 %	4 %	4 %	3/16 — 5/16	3/16 — 5/16	..	..	..	6 8 0
245,500	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	1/16 — 1/16	1/16 — 1/16	..	..	..	7 5 5
245,000	Do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	95 — 98	95 — 98	96½	..	..	4 11 10
37,350	Telegraph Construction and Maintenance	12	20 %	15 %	15 %	15 %	31 — 33 xd	31 — 33	31½	31	..	5 9 1
150,000	Do. 4 % Ded. Bds., 1 to 1,500 Red., 1909	100	4 %	4 %	4 %	4 %	99 —102	99 —102	..	..	..	3 18 5
599,200	Undergd. E. R., Lon., 5 % Profit Shar. S. Nts.	..	..	5 %	5 %	5 %	64 — 67	64 — 67	64½	64½	..	7 9 3
66,666	Willans & Robinson, 1 to 30,000 & 80,001 to 116,666	5	3 %	Nil	Nil	..	1¼ — 1⅜	1¼ — 1⅜	..	..	..	Nil
66,666	Do. 6 % C.P., 30,001 to 80,000 & 125,001 to 141,666	5	6 %	Nil	Nil	..	3⅜ — 4¼	3⅜ — 4¼	81/-	80/-	..	Nil
246,574	Do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	76 — 80	76 — 80	..	..	..	5 0 0

ELECTRICITY SUPPLY COMPANIES.

14,000	Bromley (Kent) E.L. & P,. 1 to 14,000	5	5 %	5½%	5½%	5½%	4⅜ — 5¼	4⅜ — 5¼	..	..	..	5 4 9
70,000	Do. do. 4½ % 1st. deb. stock	100	4½%	4½%	4½%	4½%	98 —100	98 —100	..	..	..	4 10 0
29,798	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	5	10 %	10 %	10 %	10%	7⅜ — 8⅜	7⅜ — 8⅜	..	..	..	6 1 8
10,202	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	7⅛ — 8¼	7⅛ — 8¼	7 13/16	..	..	4 2 4
336,876	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	99 —102	99 —102	..	..	..	3 18 5
80,000	Charing Cross and Strand Electricity Supply	5	8 %	8 %	5 %	5 %	3¾ — 4	3¾ — 4	77/6	..	..	6 5 0
80,000	Do. do. do. 4½ % Cum. Pref.	5	4½%	4½%	4½%	4½%	3⅜ — 4¼	3⅜ — 4¼	..	..	..	5 5 11
80,000	Do. "City Undertaking" 4½ % Cum. Pref.	5	4½%	4½%	4½%	4½%	3¾ — 3⅞	3¾ — 3¾	..	..	..	6 0 0
427,400	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	95 — 98	95 — 98	..	..	..	4 1 8
49,436	Chelsea Electricity Supply, Ord.	5	5½%	6 %	6 %	4½%	3¾ — 4¼	3¾ — 4¼	..	..	..	5 0 0
175,000	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	101 —104	101 —104	..	..	..	4 5 9
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	10	5 %	6 %	6 %	6 %	9 — 10	9 — 10	9⅜	9½	..	6 0 0
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	10⅜ — 11⅜	10⅜ — 11⅜	11 1/16	..	..	5 2 2
400,000	Do. 5 % Db. Stk., Scrip. (iss. at 115) all pd.	..	5 %	5 %	5 %	5 %	121 —124	121 —124	..	..	..	4 0 8
800,000	Do. 4½ % 2nd. Db. Stk., Prov. Crts., all pd.	100	4½%	4½%	4½%	4½%	96 — 99	96 — 99	97⅛	..	..	4 10 11
40,000	County of Durham Electrical Power, Ord.	5	4 %	£3 7 0	4 %	4 %	4½ — 5	4½ — 5	..	..	..	4 0 0
50,000	Do. do. do. 5 % Pref.	5	5 %	5 %	5 %	5 %	4¾ — 5	4¾ — 5	..	..	..	5 0 0
40,000	County of London Electric Lighting, Ord. I—40,000	10	4 %	4½%	5 %	5 %	7 — 8 xd	7 — 8	7½	..	..	6 5 0
40,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	6 %	10½ — 11½ xd	10½ — 11½	..	..	..	5 6 8
400,000	Do. do. 4½ % Deb. Stock	..	4½%	4½%	4½%	4½%	106 —109	106 —109	107½	107⅜	..	4 2 7
400,000	Do. do. 4½ % 2nd. Deb. Stock	Stock	4½%	4½%	4½%	4½%	94 — 97	94 — 97	..	..	..	4 12 9
80,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	4 %	Nil	¾ — 1	¾ — 1	..	..	..	11 0 0
80,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	3 %	1¾ — 2¼	1¾ — 2¼	39/3	..	+ ⅛	6 13 4
350,000	Do. do. 4½ % 1st Mort. Deb. Stk.	100	4½%	4½%	4½%	4½%	76 — 81	76 — 81	..	..	..	5 11 1
10,000	Folkestone, 1 to 10,000	5	5½%	5½%	5½%	5½%	4⅞ — 5⅜	4¾ — 5⅜	..	..	..	5 8 5
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	..	..	5 %	5 %	5 — 5⅜	5 — 5⅜	..	..	..	4 15 8
90,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	96 — 99 xd	96 — 99	..	..	..	4 10 11
13,000	Hove, 1 to 13,000	5	8½%	8½%	9 %	9 %	6⅞ — 7⅛	6⅞ — 7⅛	..	..	..	6 4 2
21,000	Kensington and Knightsbridge Electric Ord.	5	12%	12 %	10 %	10 %	8¼ — 9¼ xd	8¼ — 9¼	..	..	..	5 8 1
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	94 — 97 xd	96 — 99	..	..	..	4 2 6
111,000	London Electric Supply Corporation, Limited, Ord.	3	Nil	3 %	4 %	4 %	1⅜ — 2⅛	1⅜ — 2⅛	..	..	..	5 12 3
70,000	Do. do. do. 6 % Pref.	5	6 %	6 %	6 %	6 %	4¼ — 5¼	4¼ — 5¼	..	..	..	5 17 1
374,395	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4 %	4 %	4½%	93 — 96	93 — 96	..	..	..	4 13 9
200,000	Metropolitan Electric Supply, 1 to 100,000	5	82%	10 %	10 %	8 %	5¾ — 6¼ xd	5¾ — 6⅛	..	..	..	6 3 1
76,121	Do. 4½ % Cum. Pref. 1—71,106	5	4½%	4½%	4½%	4½%	4¼ — 5¼	4¼ — 6¼	97/6	..	..	4 5 9
220,000	Do. 4½ % 1st Mort. Deben. Stock	..	4½%	4½%	4½%	4½%	103 —107	103 —107	..	..	..	4 4 1
250,000	Do. 3½ % Mort. Deben. Stock Redem.	Stock	3½%	3½%	3½%	3½%	87 — 92	87 — 92	..	..	..	3 16 1
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	4½%	95 — 98	95 — 98	..	..	..	4 11 10
67,991	Newcastle-on-Tyne	5	8 %	8 %	8 %	8 %	7⅜ — 7⅝ xd	6¼ — 7	..	..	— ⅛	5 14 3
75,000	Do. 5 % Pref., 1 to 75,000	5	5 %	5 %	5 %	5 %	4¾ — 5¼ xd	5 — 5⅛	5 7/16	..	— ⅛	4 10 11
10,852	Notting Hill Electric Lighting	10	6 %	7 %	7½%	7½%	11¼ — 12¼	11 — 12	..	..	— ½	6 5 0
20,000	Oxford, 1 to 96 and 407 to 20,310	5	6⅔%	7 %	7 %	7 %	5¼ — 6⅜	5¼ — 6⅜	5⅜	..	..	5 9 11
50,000	Do. 4 % Deb. Stock	100	4 %	4 %	4 %	4 %	95 — 97	95 — 97	..	..	..	4 2 6
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½%	12½%	10 %	7⅜ — 8⅞ xd	7⅜ — 8⅞	..	..	..	5 14 3
20,000	Do. do. 7 % Pref. 20,081 to 40,080	5	7 %	7 %	7 %	7 %	6⅜ — 7⅜ xd	6⅜ — 7⅜	..	..	..	4 14 11
150,000	Do. do. 3½ % Deb. Stock Red.	100	3½%	3½%	3 %	3½%	86 — 91	86 — 91	86½	83	..	3 16 11
12,000	Smithfield Markets Electric Supply, Ord.	5	4 %	4 %	4 %	Nil	¾ — 1⅛	¾ — 1½	..	..	..	Nil
50,000	Do. do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	71 — 75 xd	71 — 75	..	..	..	5 6 8
65,000	South London Electricity Supply, Ord.	5	3 %	4 %	4 %	3 %	2 — 2½	2 — 2½	..	..	..	6 0 0
120,000	South Met. Elec. Lt. & Power, Ord.	1	Nil	Nil	2½%	2½%	⅝ — ¾	⅝ — ¾	..	..	..	3 6 8
117,968	Do. do. 7 % Pref.	1	7 %	7 %	7 %	7 %	1¼ — 1⅜	1¼ — 1⅜	..	..	..	5 1 10
200,000	Do. do. 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	4½%	100 —103	100 —103	..	..	..	4 7 5
80,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	5 %	1¾ — 2¼	1¾ — 2¼	..	..	..	11 2 0
50,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	2 — 3	2 — 3	..	..	..	8 6 8
200 000	Do. do. 4½ % 1st Mort. Db. Stk. Red.	100	..	4½%	4½%	4½%	94 — 97	94 — 97	..	..	..	4 12 9
110,000	Westminster Electric Supply, Ord.	5	13½%	14 %	13 %	12 %	9 — 10	9 — 10	9⅜	9½	..	6 0 0
81,279	Do. do. 4½ % Cum. Pref. (Original 5 %—Red. to 4½ % from 31st Dec., 1905)	5	5 %	5 %	5 %	4½%	5 — 5⅛	5 — 5⅛	..	..	..	4 1 10

* Unless otherwise stated, all shares are fully paid. † Quotations on Liverpool Stock Exchange.

Bank rate of Discount 4 per cent. April 25th, 1907.

EXPERIMENTS WITH CONCRETE TELEGRAPH POLES.*

Consideration shows that the length of life of steel, without adequate preservative agencies, is not much greater than that of the long-lived woods. A great many patterns of steel poles have been made, but probably very few of them represent our practical desideratum. Among them are poles cut from I-beams; tubular poles made of pipe jointed together; tubular poles of special design and manufacture; poles made of plates bolted together; poles of angles fastened together by lattice-work, and sundry other forms. But thorough study of the matter brings the conclusion that, to have sufficiently long life for consideration, the inside as well as the outside of any steel pole must be accessible for the purpose of inspection and reapplication of preservatives.

So far as can be ascertained, the preservation of steel imbedded in properly constructed concrete is perfect. Concrete not only does not disintegrate, but hardens and improves with age. Therefore, a structure of reinforced concrete has a life that is practically unlimited, and a telegraph pole made of reinforced concrete ought to answer the purpose for which it is erected.

The use of concrete for the manufacture of telegraph poles is not new. As nearly as can be ascertained, the first concrete poles were designed by Colonel G. M. Totten, chief engineer of the Panama Railroad Co., at a date uncertain, but probably about 1856, the road having been put into operation in that year. These poles were cone-shaped, 12 ft. long, with a diameter of from 12 to 15 in. at the base and from 6 to 8 in. at the top. The wires were supported by iron brackets, which were fastened to the poles by wrought-iron bands passing around them and around the poles near the top. The proportions of the ingredients used in the manufacture of these poles is not obtainable, but the strength to resist strains was so inadequate that means were sought to overcome this fault, and the poles were a few years later replaced from time to time by the first reinforced concrete poles of which record is known, the reinforcement consisting of 3 in. × 3 in. pine cores, extending throughout the length of the poles. The concrete poles, it is understood, were used because the available wooden poles were very short-lived, by reason of the ravages of insects. The poles with wooden reinforcement evidently were not attacked by the ants soon enough to prevent the cores from swelling and cracking the concrete, so that the first pattern of reinforced poles was not an appreciable improvement over the solid pole. After being used for a few years, the disruption of both classes of poles was such that they were practically abandoned, they having been replaced as occasion required by other patterns until, in 1898, there were only about twenty of the original poles standing, one or two of which still remain erect on the line of that road.

The "Geological Survey of Ohio," 4th Series, Bulletin 2 (1904), entitled "Uses of Hydraulic Cement," by Prof. Frank Harvey Eno, of the Ohio State University, presents in an article entitled "Cement Telegraph Poles" an item of some interest, describing cement butts for wood poles that have rotted off, observing that when a pole has to be replaced, often only the part setting in the ground has deteriorated, and, while in some country districts the pole may be cut off and reset, there are many poles that must be replaced altogether, thus losing most of the pole. To meet this contingency, a cement base has been devised, octagonal in shape, with four iron strips bolted to opposite faces, extending a foot or more above the concrete. In installing this concrete base, the rotten pole is sawed off, the lower end swung a little to one side, the cement base put in the place of the rotten stump, and the pole is then swung into the socket formed by the iron strips and securely bolted. The pole when thus equipped is alleged to be better than new. In restumping in the manner just outlined, no wiring need be touched, nor telegraphic communication interfered with in the least. Another feature of the use of these cement butts is that when a pole has deteriorated beyond the point of usefulness, and has to be replaced, a pole 5 ft. shorter can be furnished, thus materially reducing the cost. The article quoted stated that these butts had been in use for three years, and were giving good satisfaction. The practice of restumping is largely followed in the present day, except that stumps of wood are used instead of those of concrete.

The *Cement and Engineering News* for August, 1902, mentions with strong approval the cement butts manufactured at Battle Creek, Michigan, giving about the same points as stated, and estimating that a saving of from 35 to 55 per cent. is realised by the use of these butts in construction.

Mr. Robert A. Cummings, member A.S.C.E., a consulting and constructing engineer of Pittsburg, made, in 1903, some experimental concrete telegraph poles at Hampton, Va., and found them to be quite satisfactory for ordinary purposes. The cross-section was that of an equilateral triangle with 12-in. sides at the bottom of the pole and 6 in. sides at the top. The poles were 30 ft. long, and were reinforced with ⅝ in. vertical rods at the corners. They were stiff enough to support their own weight with a span of about 20 ft. At that time Mr. Cummings had not seen any concrete poles in actual use, but said he had designed some large distributing poles for the New York Telephone Co.

The United Electric Railways Co., of Baltimore, has used cement tramway poles with good results. Mr. Alexander Crawford Chenoweth, of Brooklyn, made in 1906 some cement poles 60 ft. long and 14 in. in diameter, calculated to withstand a direct pull of 8 tons and a torsion from a yard-arm 4 ft. long equal to 4 tons. These poles, erected in place, cost $2½ a foot. They were built to carry a 4-in. cable, high power, direct-current transmission, the spans being 500 ft.

A notable example of recent construction of a pole of mammoth proportions is that of the reinforced concrete tower for the West Pennsylvania Railway Co.'s transmission line, spanning the Monongahela River at Brownsville, Pa. This structure, which is 150 ft. in height, supports cables through a span of 1,014 ft., crossing the Monongahela River. The cables are attached at an average height of 105 ft. from the base of the pole, which is backed up by a shorter structure of the same construction, used as an anchorage tower. Both towers were designed as cantilever beams, and are mentioned as examples of how these erections are extending. The details of construction are outlined by Mr. F. W. Scheidenhelm in the issue for May 2nd, 1907, of the *Engineering News*, who designed and constructed the towers.

After a somewhat extensive series of experiments made some time since, Mr. J. L. Weller, member of the Canadian Society of Civil Engineers, and superintending engineer of the Welland Canal, built and erected a power line along the Welland Canal, using reinforced concrete for the manufacture of the poles. The poles in this line stand from 45 to 70 ft. in height, and were designed to withstand a horizontal pull at the top equivalent to 2,000 lb. These poles have been standing in the line for more than three years and are apparently in good condition.

In the working out of the plans for the requisite strength with the minimum of weight, two hollow poles were made. One of the patterns was square in section, with the corners chamfered off; the other, octagonal in section, and the hollow space extending from the base for about two-thirds of the length of the pole, the upper third being solid, and the walls of the lower two-thirds being from 1½ in. to 3 in. thick. These poles weighed approximately thirty-five hundred pounds, and were calculated to withstand any stress in any direction that could possibly be imposed upon them by a line of fifty wires, each wire coated with sufficient ice to make it 1 in. in diameter. The test was made in connection with two carefully-selected cedar poles of the same length (30 ft.), and all were set in concrete, the bases being 3 ft. × 3 ft. × 5 ft. deep.

Just within the outer surface, the walls of the concrete poles were reinforced with iron rods, which consisted of four ¾-in. round bars, each 24 ft. long, and four ⅝-in. round bars of the same length. The poles were 8 in. in diameter at the top and 13 in. at the base, having a taper of 1 in. to 5 ft. Galvanised iron steps were screwed into wooden blocks moulded into the concrete, and holes were left for through bolts for supporting the cross-arms. The cross-arm braces were attached to the arms by through bolts in the same manner, and fastened to the poles with ordinary lag bolts driven into wooden plugs which were placed in the concrete at the proper places. The concrete poles were set to a depth of 5 ft. in concrete with two white cedar poles of practically the same dimensions, and, after standing long enough to permit the cement to become solid, they were tested in turn in the following manner: An iron device was placed around the pole to be tested, 10 in. from the top, to which a wire rope was attached, leading over a pulley placed at the same height and at an equal distance from the pole so as to form a right-angle, and fastened to a differential pulley-block which was attached to a laboratory weighing machine.

After the cement poles had been broken, the reinforcement so held them that it required almost the breaking pressure to further deflect them from their slightly inclined position. The wooden poles, under strain, presented the form of an arch before breaking, and when they gave way were fractured completely; but these features were lacking in the cement poles, which were very firm and did not give until they began to crush at the ground line.

The mixture used in these cement poles was 1—3. They were constructed in cold weather, and, through some mischance, at the last moment we were unable to get suitable gravel. Pole No. 1 was found to have a defect in the casting, which is believed to have been the cause of its early rupture. Pole No. 2 gave a very much better result. The consensus of opinion seems to be that a 1-2-4 mixture is the best for use in this class of construction, and, while the experiments thus related were entirely satisfactory in the development of the problem, the hollow pattern is not considered to be the highest type desirable; that is, to combine sufficient strength with the least possible weight, in order to obtain ease in handling, and that the removal from place to place may be readily feasible.

To fulfil these requirements, the pole should be made with a superstructure of somewhat greater strength than the wires which it is required to support, joined to sufficiently added strength by reinforcement and added area in the base, especially at the ground line; and the base should be reinforced in the most effective way to withstand the extreme pressure at the point of fulcrum. These conditions are all capable of mathematical computation, and if fulfilled, will give a product comparatively easy of manufacture, of reasonable cost, of greater tensile strength than the poles now in use, and extremely high durability.

* Abstract of paper read by Mr. G. A. Cellar, Superintendent of Telegraph of Pennsylvania Lines West of Pittsburg, before the Convention of Railway Telegraph Superintendents at Atlantic City, N.J., June 19th, 20th, and 21st, 1907.

Electrical Accidents in Germany in 1906.—A table is given by *l'Industrie Electrique* of accidents due to electricity and other illuminants, resulting in personal injury. Of these, 35 were fatal, 46 serious, and 42 of small importance. Most of the fatal accidents were due to carelessness, foolhardiness or drunkenness. Two resulted from attempts to steal electricity.

THE EAST INDIAN TELEGRAPH SERVICE.

A period of slightly over a year elapses between the termination of the Indian financial year and the time when the India Office is in possession of complete information regarding the working of the Government departments in East India for that particular period. This is the explanation for the belated appearance of the Blue Book on the material progress of India during the year 1905-6, which was published at the end of May of this year. The section relating to the Indian Post Office and Telegraphs is divided into two parts for telegraphy, the first dealing with the system under the direct control of the Government of India, and the second with the system of the Indo-European Telegraph Co.

The statement points out that the Government system consists of 64,383 miles of telegraph line, 243,212 miles of wire, and 348 miles of cable. After referring to the Royal visit in 1905-6 and to the reductions made in the charges for foreign telegrams and alterations in inland rates, the reader is informed that the organisation of the telegraph department has occupied the attention of the Government of India. A Committee, presided over by Sir Lewis Tupper, K.C.S.I., C.I.E., was appointed to make a thorough investigation into the methods of working and the recruitment of the staff, and as the inquiry was to commence on September 28th, 1906, and to last six months, the report of the Committee should be ready at the present time. The results of the working of the Government telegraph system during the year may be regarded as satisfactory. It appears that the gross receipts amounted to £815,611, and exceeded those for 1904-5, which was the previous best on record, by £42,418. On the other hand, the working expenses reached £599,052, an increase of £52,138 over the preceding year, and thus the net revenue for the year was £216,559, representing a return of 3·33 per cent. on the capital outlay. This percentage is the lowest recorded since 1884-5. The progress made in recent years is illustrated below:—

—	Capital expenditure.	Miles of line.	Miles of wire.	Miles of cable.
To beginning of 1901-2 ..	£4,728,223	55,055	181,888	289
During 1901-2	247,741	772	8,721	13
,, 1902-3	328,612	1,008	9,663	16
,, 1903-4	244,629	2,862	11,771	25
,, 1904-5	274,826	1,992	15,398	21
,, 1905-6	380,474	2,699	15,776	34
Total	£6,204,505	64,383	243,212	348

The number of telegraph offices open to the public at the end of 1905-6 was 6,723, of which 5,177 were maintained by the Government department. The financial position in the past five years is briefly as follows:—

—	Gross receipts.	Net receipts.	Return on capital.
1901-2	£730,395	£297,057	4·56 per cent.
1902-3	737,211	208,229	3·92 ,,
1903-4	730,994	192,722	3·47 ,,
1904-5	755,274	218,360	3·75 ,,
1905-6	805,748	266,696	3·33 ,,

The annual expenses connected with the telegraphs in India, whether on capital account for the construction of new lines or on revenue account for the maintenance and working of the system, are defrayed from the revenues of the Government of India. In 1905-6 the receipts of the department were not sufficient to cover both the working expenses and the amount expended on capital account, and there was therefore a charge of £173,778 on Government revenues.

The subscriptions to the Telegraph Department for telephone and similar services rendered during the calendar year 1905 amounted to £15,524, being an increase of £1,889 over 1904. The average annual subscriptions in the five years ended 1905 reached £12,880. A double-circuit telephone line 68 miles long was erected between Khargpur and Shalimar for the use of the Bengal-Nagpur Railway, this being the longest direct working line in India. The gross receipts of the telephone companies during 1905 amounted to £38,661, or £2,971 in excess of the previous year, and their average annual earnings were £34,281 in the five years ended with 1905. The statement also refers to the international traffic to and from India over the several routes to Europe for the year 1905-6, the Red Sea route *vid* Suez representing 54·02 per cent. of the total messages, and the Indo-European route the remainder, by way of Teheran, Turkey and the Persian Gulf *vid* Karachi.

The second part of the telegraph statement mentions that the system of telegraph lines and cables connecting the terminus of the Indo-European Co.'s telegraphs at Teheran with the Indian telegraph system at Karachi is controlled by the Indo-European Government Telegraph Department, and consists of two sections. The first, designated the Persian Gulf section, extends by cable from Karachi to Bushire, Jask to Muscat, and Bushire to Fao, where a connection is made with the Ottoman Government line, and by landlines along the Mekran coast from Jask to Gwadur and thence to Karachi. The second, which is called the Persian section, consists of landlines running from Bushire to Teheran. The system comprises 1,951 n. miles of cable, 1,431 miles of line and 3,593 miles of wire. A line is also maintained by the department from Teheran to Meshed, a distance of 568 miles, this being the property of the Persian Government. The Central Persian line, which was commenced at Kashan at the end of 1902, has been completed through Yezd, Anar, Kerman, and Bam to a point 25 miles beyond Bam, and 596 miles distant from Kashan. Beyond this a single-wire line 211 miles long has been constructed to form a connection with the Indian line from Quetta to Robat. A line from Karachi to Panjgur was commenced in September, 1905, and 170 miles had been finished at the end of the year. It is intended to continue this line to meet the Central Persian line at a point near Robat.

The administration of the Indo-European department was again transferred to London in 1893, and placed under the direct control of the Secretary of State, and separate accounts for this department are kept. It appears that the net result for 1905-6 was a profit of £51,625, or 5·39 per cent. on the capital expenditure of £957,491. This compares with 4·40 per cent. in 1904-5, 4·97 per cent. in 1903-4, 4·50 per cent. in 1902-3, and 7·89 per cent. in 1901-2, when the total capital outlay was £818,747. It is considered that the results of the year's working were generally satisfactory. Interruptions totalling 21 days 8 hours and 53 minutes occurred on the Indo-European Co.'s lines between Teheran and London, mainly due to revolutionary disturbances in Russia. In conclusion, it is stated that the working of the Turkish route between Fao and Constantinople continued to be unsatisfactory, the interruptions during the year lasting 41 days 4 hours and 5 minutes.

REVIEW OF THE L.G.B. DEPARTMENTAL COMMITTEE'S REPORT RELATING TO ELECTRICITY SUPPLY UNDERTAKINGS.

I.—The System on which the Accounts of Local Authorities should be Kept.

"*Income and Expenditure*" *System.*

Par. 26.—"The expression, Income and Expenditure, has received among accountants generally a recognised and fairly definite meaning, and is now taken to imply the inclusion in the accounts of any given period of all incomings and outgoings pertaining to that period whether actually received and disbursed or not."

Par. 27.—"A system restricted to actual cash received and paid has the merit of simplicity. This advantage, however, is obtained at the cost of completeness. In so far as accounts are strictly limited to cash transactions, they do not include every part of a transaction as and when it takes place, but only that part of the transaction which is represented by a cash payment."

Par. 28.—"More general, but very important, objections to the Receipts and Payments system are that it is difficult, if not impossible, to produce therefrom a statement of profit and loss, when required, and that it does not lead up to a balance-sheet showing the true financial position. Many of the witnesses have referred to the possibility under this system of deferring payments so as to exclude them from the accounts of the year to which they properly belong, and it has been stated that in some cases this has actually been done."

Par. 29.—"An Income and Expenditure system contains a record of every step in a transaction as it takes place. It thus affords protection against negligence or irregularity, recording as it does all items payable or receivable by debits and credits which must remain on record until properly discharged. It ensures the presentation of the transactions of any given period completely and accurately, and is necessary for arriving at a correct statement of profit or loss and of the financial position."

Par. 30.—"Under this system the accounts of any period would include accrued proportions of such items as rents, salaries and wages, or interest on loans, quite irrespective of the date on which the actual payment may be or may become due."

Par. 32.—"There are two principal objections of a general character which have been suggested against the Income and Expenditure system:—

"First, is the undesirability of admitting into the accounts, as final records, items that may have to be estimated as incomings or outgoings when the actual amounts cannot at the time be ascertained. We think that the inclusion of estimates in the account should be avoided, as far as practicable; at the same time, we think it better that the nearest ascertainable sums should be recorded in the accounts of the year to which the items belong, subject to subsequent adjustment, than that items of a substantial character should be omitted from these accounts and included in the accounts of a subsequent period. If proper care is exercised with regard to the estimates in these exceptional cases, and if the detailed statements on which they are based are subject to efficient audit, the discrepancies between the actual and the estimated amounts should not be considerable.

"The second objection lays stress on the delay in closing the accounts, which might ensue from the adoption of the use of the Income and Expenditure system. Accounts of cash receipts and payments can be closed immediately after the end of the period; but there are difficulties in getting in the necessary items of information relating to outstanding matters of account. We believe, however, that under a proper system of administration this difficulty will be overcome. Witnesses have informed us that they

have found no difficulty in closing accounts of considerable magnitude within a month or two of the end of the financial year."

Par. 36.—"It is thought that the Income and Expenditure system requires a higher training in accountancy than is generally possessed by the officers of smaller authorities, and that it would involve additional clerical work, and consequently extra expense. But where the transactions are simple, the accounts need not be complicated; and we believe that, with a little experience, any officer of average ability will find no difficulty. It was stated in evidence that an increase of staff would be required only in the case of those authorities whose accounts are at present inefficient; and in such cases the enhanced value of the accounts should more than compensate for a little additional expense."

Par. 38.—"The accounts for the year in which a change to the Income and Expenditure system is first made will have to deal not only with the income and expenditure properly belonging to that year, but, in addition, with certain items which properly belonged to the preceding year. For purposes of comparison with the accounts of other years, the Committee consider that it will be necessary that the latter items should be distinguished in the abstract of the accounts of this year by being shown in a separate column, or otherwise, and that the accounts should be so kept that this may readily be done."

To the average commercial man the foregoing extracts may appear to be a very long-winded method of presenting a simple proposition, but it must be remembered that business men are not dealing with the subject either in presentation, consideration or decision. No business man, for instance, would suggest that the Income and Expenditure system would require higher training in accountancy than is generally possessed by an ordinary ledger clerk earning, say, 30s. to 35s. per week. The expression "That with a little experience any officer of average ability will find no difficulty," &c., is decidedly naïve, and rather suggestive of present-day inefficiency.

Of course, there can be no doubt that the Income and Expenditure system is the only practical one as applied to any trading concern, and the only difficulties that present themselves are those incurred in estimating loss—*e.g.*, discount on outstanding accounts and bad debts. For this purpose it would be necessary to establish a suspense account, to which a sum should be carried from revenue account which may be considered sufficient to cover any bad debts likely to accrue to the particular year to which the estimate may apply, whilst discounts may be treated by a definite system as follows :—

Assuming that the outstanding balance at April 1st amounted to, say	£8,000
And private sales during the following year to ...	25,000
	£33,000
And the outstanding balance at March 31st was ...	9,000
Accounts received	£24,000
On which discount had been allowed	600

or 2½ per cent.; then the amount to be carried to suspense account would be 2½ per cent. on £9,000 = £225.

By the inclusion of accrued wages the question of daily allocation of costs is opened up, because, should the end of the financial year occur in mid-week, an estimate of wages is insufficient, inasmuch as the amount estimated could not be definitely allocated, and this must be done in order to preserve a system of accurate cost keeping. We rather think that this would be a blessing in disguise, as it would then enable the engineer to note day by day each item of expenditure, including all costs and work in progress.

It is interesting to note that Par. 30 includes interest only in connection with accrued loan service charges; this is hardly assimilable with the instruction of the L.G.B. auditor to metropolitan local authorities, which states that accrued redemption must also be included, a subject which we dealt with very fully in our issue of July 26th.

The second objection raised by the Departmental Committee, viz., delay in closing accounts, is of no material importance. We know for a fact that it is possible to close books of considerable magnitude within one or two weeks instead of after the close of the financial year. The greatest difficulty of this class experienced by local authorities is to obtain departmental accounts, but in boroughs where the works departmental books are brought into line with those of the electricity department, no delay is experienced.

Par. 38 deals with the accounts for that year in which the change-over system comes into force. We do not consider that the two-column system is a good one. It would be a simple matter to open an adjustment account for that particular year and debit the same with all accrued liabilities, and credit all advance charges (which would probably comprise insurances and stock of stationery), carrying the balance to the debit of working capital account.

Reviewing the whole of the recommendations referring to the Income and Expenditure system, we think they indicate a desire to place the trading departments of local authorities on better business lines than have hitherto been followed.

REVIEWS.

Modern Steam Engineering. By GARDNER D. HISCOX. London: Crosby Lockwood & Son. 1907. Price 12s. 6d. net.

This book is intended to be an exposition, without serious mathematics, of the principles and practice of steam engineering. To this end the subjects of superheated steam, slide valves, piston valves and Corliss gears are dealt with, as well as compound engines of various stages, the indicator and the turbine. To begin with, there is a good deal of history and a diagram of efficiencies, from the old-time 10 lb. of coal per H.P.-hour to the present-day consumption of 1 lb. Then follows a useful table on steam and its properties, together with a table of boiling points of salt solutions.

Furnaces, fuel and steam generation occupy the next chapter. Surely it is a misprint on page 31, where the total combustible of anthracite coal is said to average only 90 per cent. On the whole, this is a very good chapter, and grates are well illustrated, all, however, being American designs or modifications of older English grates. Several atomisers for liquid fuel are illustrated, but without comment or criticism, whereas one at least of those illustrated was not well spoken of by the U.S. Naval authorities when they tested it.

Numerous types of boilers and settings are then illustrated, together with sundry accessories, and there is a section on riveted seams, strength of shells, &c. Chapter V treats of chimney draught, and here we should like to trample on the use of the term horse-power as applied to boilers, for, after all, this boiler horse-power is but an arbitrarily assumed unit of evaporation, and one might just as well refer directly to the evaporative power in pounds per hour.

After a brief section on forced draught, there is a chapter on feed-water heat economy, confined chiefly to brief references to a few feed heaters, and so on. We find similar chapters on injectors and pumps, on incrustation, condensers and air pumps, on steam and its properties, and we note that the critical temperature is given as 1,592° F., at which point latent heat disappears as regards evaporation and steam and water are the same thing. The next chapter deals with the flow through orifices and long pipes, and is, perhaps, too brief.

Chapter XI, on superheat, is fairly good, but is not up to date, no really modern type of superheater being shown, and no control system. The author exposes some of the popular fallacies concerning the supposed advantage of superheat in regard to the thermo-dynamic law. As the author says, this law does not come into the question. But these remarks appear almost a paraphrase of what has already been stated by English writers who have been for some time urging sounder views of superheat.

What are we to think of a description of a superheater which, when steam ceases to flow through it, requires large air doors to be opened, to admit air to keep the superheater cool? Yet this is passed without comment, as though it were correct practice to let in air in this wholesale manner. It may be correct to prevent the tubes from burning, but they ought to be so designed that they will not burn, but will be preserved by proper water circulation. The author, in short, appears to be behind time in his superheat practice.

After this come chapters on expansion, on steam waste from leakage, on theoretical efficiency, and on various practical points in steam working. Then follow chapters on the indicator and its application, on the planimeter, and on engine proportions, with numerous drawings of parts. Valve gears

are next dealt with, and at Chapter XVII we find the compound engine treated of; here again the matter is descriptive of things done rather than doctrinal. A short section is allotted to various turbines.

The remainder of the book includes chapters on mechanical refrigeration, on the elevator, and on the engineer and his duties; and there is a final electrical section also of a practical working nature, and dealing with matters of testing and running with switchboards, &c., batteries and lamps.

We think that, on the whole, the author has produced a very useful work that will be much appreciated by the readers for whom it has been written.

Electrons, or the Nature and Properties of Negative Electricity. By Sir Oliver Lodge, F.R.S., &c. London: George Bell & Sons. Price 6s. net.

This little book of some 230 pages contains 21 chapters, and appendices from A to M. The chapters deal chiefly with "Properties of an Electric Charge," "Electric Inertia," "Determination of Speed and Electro-chemical Equivalent of Cathode Rays," "Determination of the Mass of an Electron," "Justification for the Electric Theory of Inertia," "Electric View of Matter," "Difficulties Connected with the Electric Theory of Matter," &c., and in the appendices sufficient mathematical references are given to enable the student to follow clearly the reasoning throughout the book.

To the average engineer the recent physical discoveries, beginning with the celebrated Crookes experiments with vacuum tubes, and culminating in Prof. J. J. Thomson's "counting" experiment, which has allowed the "mass" and "charge" of a negative electron to be estimated, should be of the greatest possible interest.

Most of us recollect Mr. Balfour's remark at a British Association meeting, viz., "that matter had been explained away." In this little work the evidence for and against the electric theory of matter is placed before the student in the clearest possible way. Kaufmann's experiment is carefully discussed. Briefly, Kaufmann calculated the path of the flying corpuscle of "something," assuming its mass to be wholly electrical in origin. He then obtained photographs of the actual path, which agreed with calculation, showing that the "mass" of "β" rays is wholly electrical. At present, owing chiefly to Prof. J. J. Thomson's recent paper on the effective number of corpuscles in an atom, a difficulty arises, which is dealt with in Chapter XX, and methods of overcoming it are foreshadowed.

The above is, perhaps, a bare outline of the contents of the book, but the student will find interesting observations scattered throughout it, on "Gravitation," for instance, in the appendix, and "On the Nature of Cohesion," Chapter XVI, where incidentally the action of a "coherer" is discussed.

It may be stated that the nucleus of the book was the discourse on the nature of electricity, published in 1902 in the *Journal* of the Institution of Electrical Engineers, but a very great amount of new matter has recently come to light, and has been embodied in this work.

It is mentioned that the book "is intended throughout for students of general physics, and in places for specialists, but most of it may be taken as an exposition of a subject of inevitable interest to all educated men."

The learned author is to be congratulated on having written with such brevity and lucidity a charming book, which at the present time will be welcomed by thousands. The book is a model of compactness, and is admirably printed in large clear type. It is very fittingly dedicated "to the Cavendish Professors of Physics in the University of Cambridge, and especially to the present holder of the Chair."

Les Lampes à Incandescence Électriques. By J. Rodet. Paris: Gauthier-Villars. 1907. Price 6 fr.

The author of this book has evidently aimed at providing his readers with as complete and up-to-date knowledge of incandescent lamp manufacture as is possible in these days, when new lamps and new processes are springing up every month. The book is divided into seven chapters, each dealing with a separate division of the subject.

Chapter I, which is the longest, and probably the most important, in the whole book, is entitled "General Principles." Photometers are somewhat lightly touched upon, the Bunsen disk appearing to be the end of development in this line. This chapter is rather too much given up to mathematics. For example, it takes M. Rodet two pages to prove mathematically that the illumination of a photometer screen is inversely proportional to the square of the distance of the source of light.

The Carcel and Hefner standards of light are well described, and figures are given for conversion from one to the other, but the English standard still appears as the old obsolete standard candle, no mention being made of the Pentane lamp.

The author rightly insists upon the injustice of comparing lamps by their mean horizontal candle-power, and devotes to good purpose a considerable number of pages to the consideration of the measurement of mean spherical candle-power and reduction factors from mean horizontal candle-power.

The effect of shades and reflectors of various forms is exhaustively treated in this chapter. The question of the absolute efficiency of various sources of light is also discussed.

Selective radiation receives a very large amount of attention, and, in fact, the advantage to be gained by using a filament with a bright polished surface is insisted upon right through the book. The author describes methods of determining the existence of selective radiation, and quotes authority for his statements.

Chapter II is devoted to the early history of the incandescent lamp. This chapter is well written, but the subject is not, probably, of great interest to many people now.

Chapter III is devoted to the carbon filament. The whole process of manufacture at present in vogue is well described, and includes methods of flashing, mercury *versus* chemical exhaustion, and so on. Tables of figures are given connecting voltage, candle-power and life.

Chapter IV deals with osmium lamps. The process of manufacture is well described, as well as some of the earlier experiments, since superseded.

Chapter V deals with the tantalum lamp, and Chapter VI with the Nernst lamp. Both are good descriptions of processes and results.

Chapter VII deals with the mercury-vapour lamp. The lamp, however, is the Cooper-Hewitt. No mention whatever is anywhere made of the Bastian lamp. The theory of the mercury arc is well presented, and all the different developments of this lamp are described, including the mercury rectifier.

In conclusion, we consider that Mons. Rodet has collected his material with judgment, and has presented it to the reader in a form both interesting and easy of digestion.

Copper in Cuba.—A recent trade report in the *Chemiker Zeitung* draws attention to the great mineral wealth of Cuba. Very rich copper ores exist at El Cobra, about 15 miles west of Santiago. These have been worked for 23 years, the value of the copper won already exceeding $50,000,000. The works were destroyed in 1898 during the war, but were bought in 1902 by an American company, which began to manufacture cement copper. On the shore of the bay large furnaces and refining plants have been erected, which are capable of dealing with about 300 tons of the ore per day. Latterly, however, various small difficulties have arisen, and the production during the last year was much less than that of the previous 12 months. The ore raised contains about 5 per cent. of copper. In the province of Santiago numerous other minerals are found, principally iron. Manganese has been obtained, while gold, lead, zinc and asphaltum are known to occur, but have not yet been worked. Four companies are chiefly concerned in the Cuban mineral industry. During the year 1906, some 510,500 tons of red hæmatite were exported to the United States, England, Germany, Belgium, and Nova Scotia. Most of the iron ore is still found on the surface, shafts having at present been sunk only for experimental purposes. It is expected that the exportation of iron ore will soon reach one million tons per annum.

THE DEMANDS OF LABOUR.

[In the following article the present attitude of labour, and the cost of Industrial Legislation and its probable effects, are touched upon.]

It does not seem to matter what concessions are made by employers, they may pay trade union wages, and they may concede the eight hours' day, but so long as they require a fair day's labour in return they are treated as enemies of the working man. The present Government is, in some quarters, considered to be too favourably disposed towards the working classes of the country. This opinion, however, does not appear to be shared by the representatives of labour, if Mr. Barnes correctly voices their views. In a short speech he made at the recent opening of the Co-operative Printing Society's Works in Manchester, he criticised the Government because there is a tendency to introduce the system of speed and feed checking into the State workshops. Here, then, we have a representative trade unionist, whose past experience seems to teach him nothing, objecting to machines being worked at their maximum output, notwithstanding the fact that the men who tend them are paid the trade union rate of wages, and work trade union hours.

It is deplorable, too, that some of the daily papers, which lose no opportunity of urging the imposition of a protective tariff as a remedy for industrial evils, should pander to the "ca' canny" type of workman by stigmatising the introduction of speed and feed checkers as "hustling methods." Such papers would be among the first to take sides against the workmen if it suited their circulation to do so, and they have, moreover, often advocated the introduction of American methods into English workshops.

Numerous articles have appeared recently in American technical papers on the question of trade unionism and the "open shop." An interesting paper on the subject appears in the July issue of the *Engineering Magazine* from the pen of Mr. J. W. Van Cleave, President of the American National Association of Manufacturers. In this article the author recognises the good which is in labour unionism, but insists on the principle of "equality of privileges and duties for all." He emphasises the fact that the federation and its fund will work for industrial peace and not for war, although they will fight demagogism, socialism, anarchism and all things that pretend that the rich are the enemies of the poor, that seek to establish class lines and incite hatreds in the community, and that raise their hands against the Government and social order.

In a recent number of the *Journal of Electricity, Power and Gas*, the same question is also discussed in an editorial, which says that for the first time in many years the theory and practice of the open shop is being discussed in San Francisco. Referring to the victory of the United Railroads over the trade unions, it remarks: "The right of the United Railroads to employ either members of the Carmen's Union or non-union men, as it prefers, cannot be questioned, it is an established right under the law and Constitution. Similarly, of course, non-union men have a legal and constitutional right to work for the United Railroads without interference from any organised body." So general and so passionate, however, has been San Francisco's devotion to the principles and practice of trade unionism that not 1 man in 10 was to be found who truly appreciated the American principle of individual liberty. Whilst disclaiming that the practice of the open shop is designed to crush trade unionism—it merely insists on the natural, constitutional and inviolable right of the individual to buy or sell labour, as it seems best to him—the labour unions, on the other hand, frequently depart from their own expressed principles in assuming to dictate to the employer the conduct of his business, refusing also to grant to non-union workers the right of free employment.

These opinions, as reflected in the American Press, are peculiarly applicable just now to railway matters in this country. We have before us the reports of the half-yearly meetings of the Great Eastern Co. and the South-Eastern Co., which took place the week before last.

The chairmen of both companies, namely, Lord Claud Hamilton and Mr. Cosmo Bonsor, made important pronouncements at these meetings, to the effect that they could not recognise the Amalgamated Society of Railway Servants as representing their employés. According to Lord Claud Hamilton, this society was using every means in its power to promote agitation and unrest amongst the staffs of the various railway companies. He denied that there was any general dissatisfaction among railway servants, and pointed out that the demands made by the society for increased wages, shorter hours, and other privileges, would practically mean the ruin of the Great Eastern Co. That company employs over 16,000 men who are eligible for membership in the Amalgamated Society of Railway Servants, yet only 1,400 of that number are society members. It seems, therefore, a little absurd on the face of it that a society representing only 9 per cent. of the employés should claim the right to discuss and settle terms for both themselves and the remaining 91 per cent. of the workmen.

In the course of his remarks, Lord Claud Hamilton said that the proposals of the Executive Committee of the Railway Men's Society meant that an irresponsible and fluctuating body composed of engine men, signal men, shunters, guards and men of similar station, without necessarily having any state of holding in the 1,280 millions sterling of railway property, should virtually supersede railway boards and managers.

The dividend paid last year by the Great Eastern Co. was only $3\frac{3}{8}$ per cent. on the capital, and the demand now made by the Railway Men's Society meant an increase in wages of nearly £314,000, which represents about 2 per cent. out of the $3\frac{3}{8}$ per cent. paid as dividends to shareholders.

The chairman concluded his speech with the following weighty announcement:—"In plain English, the ruin of the Great Eastern Co. would mean the partial ruin of the Eastern Counties, and the interests which those counties represent; and what would the staff of the Great Eastern Co. benefit by being the servants of a bankrupt concern, tied hand and foot to a Trade Union, rather than the free and independent members of a staff of a solvent and improving railway? We have fully and earnestly considered the alternative before us, and we do not intend to recognise the Amalgamated Society of Railway Servants."

What will be the effect of this decision, which will, of course, be the decision of the other railway companies, it is not possible to say at the moment, but it will be well for the Society concerned to consider very carefully the interests not only of their own members, but also of the very large body of workers in other branches of industry who depend upon a continuation of the railway systems.

The crystallised experience of centuries is embodied in certain oft-repeated formulas, such, for instance, as the following:—"You cannot burn the candle at both ends," and "you cannot eat your cake and have it." The practical application of such axioms to industrial affairs is, however, sometimes lost sight of, and it has probably never occurred to many of our labour leaders that they cannot have industrial legislation without paying for it. Every Act of Parliament which has for its object the regulation of, or interference in, industrial operations adds something to the costs of production which must necessarily re-act upon the labour market.

In an article by Mr. T. Good in *Cassier's Magazine* for July, the cost of recent industrial legislation is discussed, and the facts as there expressed will probably be an eye-opener to many who have never before seriously considered the matter from this point of view. It was considered by those responsible for the Workmen's Compensation Act of 1897, that insurance companies would undertake the risks at rates of about 1s. 6d. per £100 of wages paid. This estimate, as later events proved, was very much too low, and in 1905 the rates in the textile trades had reached about 6s. per £100 of wages. In the same year the Board of Trade returns showed that upwards of 10s. per £100 of wages was paid in workmen's compensation. The rates last year of the Iron Trade Employers' Association reached an average as high as 13s. 11d., and the present rate is over 14s. Some manufacturers in the iron and steel trade are known to pay considerably more than £1 per £100 of wages in compensation to workmen or their dependents.

The above rates, it should be understood, apply to the old

Act, and not to the new Compensation Act which has just come into force. It is impossible at present to forecast what the rate of compensation will be in future as compared with the wages paid. But, according to the *Yorkshire Post*, insurance rates in the textile trade will start at about 15s. per cent.

Assuming a basis of 12s. per cent., Mr. Good works out the probable cost in other trades based upon the relative dangers or risks. The degree of danger involved in various occupations is computed from the proportion of deaths from industrial accidents to numbers employed, as recorded in the *Board of Trade Labour Gazette* over a period of five years; and, taking the risks in textiles as unity, the risk in non-textile factories would be 3, in railway service 11, quarrying 14, mining 16, and seafaring 80·3. If, then, an average insurance premium of 12s. per cent. be imposed in the textile trades, the average on British industry generally would work out to nine times this figure, or something like £5 8s. per £100 wages paid, or, in round figures, £37,800,000 a year, calculating on our annual wages bill of £700,000,000.

An important point which Mr. Good brings out is that the whole weight of this burden will not fall on capital, but much of it must inevitably fall upon the very classes for which industrial legislation is being pushed, namely, the working classes. The feed and speed methods which are so very distasteful to our labour leaders will be pressed to greater extremes in order to effect economies in production; employers will become more and more reluctant to engage any but young and robust employés; and it will become more and more difficult for the older and less robust to obtain employment.

Turning to other branches of legislation, the author quotes the evidence given before the Royal Commission of Trade Depression by Mr. Hewlett, who said that the Mines Act of 1872 alone had added 8d. per ton to the cost of coal production; the Amendments contained in the Act of 1887 added no less than 3d. more. The Earl of Granville in a speech in the House of Lords put down the increased cost of production due to legislation within a period of 16 years at 1s. to 2s. per ton.

Again, sanitary, educational, parochial and other matters have tended to increase the cost of production, local rates having gone up within 15 years from an average of 3s. 8½d. to 5s. in the £.

The author sums up a very interesting article by showing that, so far, industrial legislation has added something like £24,000,000 a year to the cost of coal, and it will shortly add something like £37,000,000 to our other industries in the shape of workmen's compensation, and he reminds those who are forcing the pace of the industrial legislation movement that it is possible not merely to harass capital, but to inflict hardships upon the labour they seek to benefit through excessive zeal and misdirected efforts.

Dublin Exhibition.—THE D.P. BATTERY EXHIBIT.—In our recent articles on the Dublin International Exhibition we were unable to include details of the exhibit of the D.P. BATTERY CO., LTD. From information since obtained we are now able to give the necessary particulars. At this stand there are cells of the company's Strip, L.L., L.H., and L.S. types. The two former are specially suitable for country house lighting, and the L.L. type is also used for factory installations. The L.H. type has similar size plates to those of the Strip and L.L., but the plates are of a specially heavy construction, and are claimed to be the heaviest plates on the market for their capacity. This type is specially suitable for very high rates of charge and discharge, and is used for power purposes. The L.S. cells are similar to the L.H., but are made for greater capacities, and are used in electricity supply works, tramway systems, &c., and this type has either just been, or is being, erected in several places where there is a heavy load, such as to operate the cranes at Southampton Docks, the tramcars at Pontefract, &c. With the exception of the strip cells, in which the sections are supported on treated wood blocks at the bottom of the cell, the plates are suspended, and means are provided at the top and bottom for preventing the separators from getting out of position. There is also shown a stand carrying the different types of plates. The positive plates are of the Planté pattern, the active material being in the form of a very fine hard skin, and the company claim that their formation gives a good surface on the positive plates. The negative plates are pasted, the construction of the grid being such as to key in the paste securely. Some small cells in glass boxes suitable for experimental work, telegraphs, and any other work in which a large capacity is not required, are also shown.

THE FUTURE OF THE ELECTRICAL INDUSTRY.

By BEN FRANK.

["We manufacturers hold it to be a truth based upon our daily experience and knowledge that the regulation of foreign importation by Customs' duties would cheapen the cost of production . . The official representatives of our Government hold the contrary view." (Gustav Byng, Annual Meeting of G.E. Co., July, 1907.)]

WHEN, say, a reclaimed drunkard gets up in a temperance meeting to preach the virtues of sobriety, he can make use of one of the most convincing of arguments, namely, the argument of experience, in support of his views. If, on the contrary, he were to sound the praises of drink, and denounce sobriety as an effete doctrine, his audience would think, and not without reason, that some of the water he had imbibed had got into his head.

Similarly, if a manufacturer leaves a Protectionist country and builds up, under a Free Trade system, a colossal business of world-wide extent, he is not, perhaps, taken very seriously when he descants on the supposed virtues of Protection, and denies that the system under which he has become so successful, has anything to recommend it.

Granted that his arguments may be equally as plausible as those of the millionaire who extols the pleasures of poverty, they lack equally that convincing force which an appeal to direct personal experience would carry.

It is under a disadvantage such as this that Mr. Gustav Byng labours, when he so eloquently pleads before his patient shareholders the cause of protection; and many even of his manufacturing friends who agree with him would be glad if, for the sake of the cause they have at heart, they could forget his successful free trading history.

Unfortunately, too, he shares the ill-luck of those prophets who live long enough to see the falsification of their prophecies.

Thus, in 1901 he writes, "do we invite the foreign inventor and manufacturer to settle, and build and work in our country; to teach our workmen, to pay our taxes, to enrich our nation? We do not! On the contrary, we bribe him to stop away—we open our market to him so that he may concentrate upon one spot abroad all his big undertakings, and reduce his average expenses and increase his profits. We give him cheaper freights and handicap against him our own manufacturers." That was before the immigration of such foreign manufacturing competitors as the British Thomson-Houston and Westinghouse Companies. Probably the G.E. Co. have sometimes regretted, in company with other British manufacturers, that our American cousins did not confine themselves to dumping from without, rather than from within.

If we ask any motor manufacturer to-day what has been the most operative cause in reducing motor prices to the present unprofitable level, he would not, if he spoke his true convictions, refer to foreign competition, but to home competition. The whole of the foreign competition in motors never affected the English manufacturer as the home competition of the British Westinghouse Co. has done.

To turn to more recent prophesying, last year Mr. Byng told his shareholders that he would have to shut down his new carbon works unless we got protection. This year—although protection is still a long way off—he acknowledges that the carbon works have done "fairly well." It is sincerely to be hoped that they will continue to prosper, notwithstanding the pessimistic views of the founder, and surely no one should be more thankful than he, even though their prosperity rob him of an argument for tariff reform.

A few weeks ago—a week after you yourselves in an article on "The Electrical Trade" invited expressions of opinion concerning the position of the industry—a correspondence was started in the columns of the *Electrical Times* on the "Electrical Industry and Free Trade," and the discussion on the subject is still going on. One of the most interesting letters is that of Dr. Gisbert Kapp, whose opinion carries all the more weight because he has had an extended experience both in protective countries and in England; and he unhesitatingly puts the whole weight of his opinion in favour of the British system.

Touching on the general question of the depression in electrical manufacturing, an interesting letter appeared in a recent issue of this Journal from the Lancashire Dynamo and Motor Co. In this letter it is pointed out, as a plain statement of fact, that this company has paid 8½ per cent. per annum on the ordinary shares for the past six years, that more profit was made in 1906 than in 1905, that the dividends were paid after a substantial depreciation had been allowed for, and that the company is exporting a considerable number of machines to Italy, France and Germany, notwithstanding the protective tariffs.

We do not propose here to follow all the well-worn arguments which have been put forward by the correspondents on both sides, such arguments, obviously reflecting only the particular point of view of the individual writers, and failing, as they must, to convince anyone who looks at the matter from a totally different standpoint. It is abundantly clear, however, to all who are not blinded by the dust of controversy that causes other than the fiscal policy of the country have been at work to produce in the electrical industry the unsatisfactory condition of which manufacturers so loudly and so justifiably complain. Time might be profitably spent in considering some of the causes, more particularly the cost of industrial legislation with which industry is handicapped, and the undercutting among the home manufacturers.

It is, perhaps, not sufficiently realised, if it is realised at all, by the people most concerned — namely, the working classes of the country, how much the cost of production is increased by labour legislation. It has been shown that industrial legislation has, within the past 50 years, added an annual sum of something like 24 million sterling to the cost of our coal alone, to say nothing of the increased cost of production in other departments of industry, consequent upon Factory Acts, Workmen's Compensation and other legislative enactments. Again, it is computed that our industries will be taxed to something like the tune of 37 millions a year in the future for workmen's compensation alone. It is obvious that 37 millions sterling cannot be raised annually from nowhere—someone has to find it, and it means either that the manufacturer will have to be content with less profit, or that the output of the workmen must be increased, or that his wages must be decreased. It is highly desirable, therefore, that our labour leaders should not lose sight of this aspect of the matter when attempting to force through Parliament all kinds of restrictive legislation or State interference with industry.

The other consideration to which the attention of manufacturers might be increasingly devoted is the cutting competition among themselves, and the desire to secure orders at any price. Mr. Byng called attention to this matter in his address to the shareholders, where he said "prices for heavy work had been kept low mainly through internal competition." It will be interesting, therefore, to recall to mind some of the prices which have been quoted during the past year for important contracts open to public tender. It will be seen from from these that where foreign firms competed they were not usually the lowest, but in some cases were the highest tenderers. A few examples only will suffice, examples which include quotations from Mr. Byng's company.

The following figures are taken from back numbers of the ELECTRICAL REVIEW :—

September 21st, 1906.—Tenders for two three-phase 500-KW. motors and one 1,000-KW. ditto—

G.E. Co.'s tender	£4,763
Highest tender, Messrs. Brown, Boveri & Co. ...	9,912

A difference of over 100 per cent. between the lowest and the highest tender, the highest being that of a foreign firm.

September 21st, 1906.—Tenders for one 2,000-KW. steam turbo-generator—

Willans & Robinson...	£8,857
G.E. Co.'s tender	9,445
Highest tender, The Electrical Co.	13,500

A difference of over 50 per cent., the highest tenderer again being a foreign firm.

L.C.C., February 22nd, 1907—Contract for motor-generators—

G.E. Co.'s tender	£23,352
Dick, Kerr & Co.	31,162
Highest tender, Johnson & Phillips, Ltd. ...	34,191

A difference again of almost 50 per cent. of the lowest tender.

March 8th, 1907—Hammersmith contract for two motor-generator sets—

G.E. Co.'s tender	£1,240
Highest tender, Messrs. Dick, Kerr & Co. ...	2,136

A difference of about 70 per cent. of the lowest tender.

April 5th, 1907.—Fourteen induction motor-generators for L.C.C.—

G.E. Co.'s tender	£19,907
Dick, Kerr & Co.	25,374
Highest tender, Mather & Platt, Ltd.	25,805

A difference of about 25 per cent.

It is not to be inferred from the above figures, nor is it for one moment suggested, that the G.E. Co. are always the lowest—they are, in point of fact, sometimes the highest, as in the recent Greenwich contract—but they share with others the distinction of occasionally quoting what would appear to be unprofitable prices for the sake of securing contracts, and this is apparently what Mr. Byng complains of. One can quite understand a policy of this kind in the case of a firm which has a speciality, such, for instance, as a water-tube boiler. A company, for example, such as Babcock-Wilcox (to name another successful immigrant from a protected country), could afford occasionally to quote an unremunerative price in order to prevent a new competitor in their special line from getting a foothold in their market; and they are perhaps in a position to buy out or to establish working arrangements with other more formidable rivals in order to eliminate competition. The freezing-out policy is, however, a futile policy for any electrical manufacturer to adopt, and all the cutting in the world will not enable him to freeze out his many competitors. On the face of things, it would appear that some of the time of electrical manufacturers might be as usefully devoted to discussing means for preventing dumping among home manufacturers, as to harping continually upon the one string of foreign competition.

Calcium Nitrate as a Fertiliser.—Writing in the *Chemiker Zeitung* lately upon the progress made by agricultural chemistry during the year 1906, Prof. Dr. Stutzer devotes some space to considering the properties of calcium nitrate as a fertiliser. He remarks that no large quantities of this salt have yet been placed on the markets, but now that the initial difficulties of manufacturing it electrically have been overcome in the Birkeland & Eyde process through the improvements effected by the Badische Anilin und Soda Fabrik, the material will doubtless soon be obtainable on a large scale. Hence it becomes of interest to compare the value of the new product with that of sodium nitrate or Chile saltpetre, both of which contain nitrogen in the form of nitrate, although their bases are different. According to the experiments carried out two years ago by Jermakow, it seems possible that some oxalic acid is formed in plants when nitric nitrogen reacts upon grape sugar. In certain circumstances free oxalic acid is harmful, and therefore there appears to be an advantage in having some calcium salt present to combine with it. Tests have indeed shown that the absorption of nitrates by plants is much more energetic in the presence of soluble calcium salts than in their absence, although as a rule this phenomenon is not of great practical importance, because the soil in which plants are cultivated generally contains a sufficient quantity of calcium. J. Sebelien has carried out comparative experiments upon the value of sodium nitrate and calcium nitrate in sandy and loamy soils with oats and carrots, finding the two fertilisers to be of about equal value. In soils deficient in lime, however, the calcium nitrate was naturally the more valuable of the two. Calcium nitrate also proved more valuable when applied to a certain *crucifer*, *e.g.* white mustard, this result agreeing well with some older observations made by Wagner. W. Krüger has tried calcium nitrate in the cultivation of the sugar beet, and found it at least as valuable as Chile saltpetre. Belleloux has stated that calcium nitrate increases the proportion of starch in potatoes more than sodium nitrate, and Stutzer has also observed a good effect in the same case. The author remarks that the preparation of nitric acid from air and its employment in agriculture is of extremely great importance, so that laboratory and practical tests upon its value when applied to all plants cultivated for industrial purposes ought to be carried out for several years. This is the more desirable inasmuch as certain technical difficulties in the manufacture have been overcome. In the early days one of the defects of calcium nitrate was that a certain portion of the nitrogen was present in the form of nitrite. This compound was found in some experiments carried out by the author not to be harmful to established plants, but to do a considerable amount of damage during the germination of certain seeds. The calcium nitrate now manufactured in Norway is free from nitrite. Dr. Stutzer continues his article with several references to the value of calcium cyanamide, but does not appear to give us much more information on this than has already been published by him and others.

NEW PATENTS APPLIED FOR, 1907.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

17,300. "Improved combined electric connection plug and socket and switch." W. W. Buckton. July 29th.

17,303. "Electrical variable-speed device." H. S. Caink. July 29th.

17,308. "Improvements in interrupters for electric circuits." R. H. Wappler and C. F. Fayer. July 29th. (Complete.)

17,309. "Improvements in electric lamp fittings." A. Bonnella and G. J. Bonnella. July 29th.

17,326. "Improvements in or relating to the construction of insulation for magneto-electric apparatus." H. Braun and C. Bockmann, trading as Braun and Bockmann G.m.b.H. (Date applied for under Patents Act, 1901, March 26th, 1907, being date of application in Germany.) July 29th. (Complete.)

17,332. "Improvements in or relating to electric transmission at a distance." J. Mladek and W. Mladek. July 29th.

17,346. "Improvements in or connected with electric lamps." R. T. Preston and H. E. Theobalds. July 29th.

17,355. "Improved plug element for effecting temporary electrical connections." A. V. Berghe and A. T. M. Thomson. July 29th.

17,360. "Improvements in methods of manufacturing conductive filaments for use in electric lamps or other apparatus." W. D. Coolidge. (Date applied for under Patents Act, 1901, August 1st, 1906, being date of application in United States.) July 29th. (Complete.)

17,361. "Improvements in and relating to controllers for electric motors and the like." The Allgemeine Elektricitats Ges. (Date applied for under Patents Act, 1901, July 30th, 1906, being date of application in Germany.) July 29th. (Complete.)

17,406. "Galvanic sock." F. Kennedy and J. V. Davis. July 30th.

17,409. "Improved electric storage battery." E. G. F. Medley. July 30th.

17,410. "Improvement in electric switches." Siemens-Schuckert Werke G.m.b.H. (Date applied for under Patents Act, 1901, September 24th, 1906, being date of application in Germany.) July 30th. (Complete.)

17,454. "Improvements in cauteries." L. de Forest. (Date applied for under Patents Act, 1901, March 1st, 1907, being date of application in United States.) July 30th. (Complete.)

17,455. "Improvements in electric signalling apparatus." Deutsche Telephonwerke G.m.b.H. (Date applied for under Patents Act, 1901, August 24th, 1906, being date of application in Germany.) July 30th. (Complete.)

17,456. "Improved parallel break change-over switch." E. Dewhurst, July 30th.

17,457. "Improvements in and relating to electrolytic alternating current rectifiers." A. S. Hickley. July 30th. (Complete.)

17,458. "Improvements in or connected with electrolytic cells." A. S. Hickley. July 30th. (Complete.)

17,468. "Improvements in or relating to electrical ignition devices for internal-combustion engines or the like." A. J. Postans. July 30th.

17,472. "New or improved attachment for the mouthpieces of telephone instruments." T. J. Haslam, H. J. Rand and J. W. Smith, trading as The Properties Exploitation Syndicate. July 30th.

17,474. "Improvements in and relating to alternating-current motors of the commutator type, and methods of operating the same." British Thomson-Houston Co., Ltd. (General Electric Co., United States.) July 30th.

17,475. "Improvements in and relating to electric circuit breakers." British Thomson-Houston Co., Ltd. (E. B. Wedmore and W. P. Hamlyn.) July 30th.

17,489. "Improvements in electrodes for storage batteries." W. Fennell and W. P. Perry. July 31st.

17,490. "Improvement in thermo-electric generators." W. Fennell and W. P. Perry. July 31st.

17,492. "Improved anode." R. H. F. Finlay. July 31st. (Complete.)

17,515. "Improvements in electrical apparatus such as storage batteries." T. Terrell. July 31st.

17,526. "Improvements in or relating to electrically-propelled vehicles, boats and the like." P. E. Trainor. July 31st.

17,532. "Improvements in or relating to surface contact electric traction systems." E. A. Mitchell. July 31st.

17,539. "Elevated electric railways." J. M. Gilstrap. (Date applied for under Patents Act, 1901, July 31st, 1906, being date of application in United States.) July 31st. (Complete.)

17,548. "Improvements in and relating to inductor generators for ignition and like purposes." J. L. Milton. July 31st. (Complete.)

17,554. "Improvements in or connected with winches for electric arc lamps and other purposes." N. R. Nichols and J. B. Le Maitre. August 1st.

17,557. "Improvements relating to electrical cut-outs for arc lamp and other circuits." Veritys, Ltd., and F. S. Worsley. August 1st.

17,565. "Improvements in switches combined with fuses." J. H. Ward, M. H. Goldstone and A. Goldstone. August 1st.

17,577. "Improvements in and relating to apparatus for X-rays screening and stereoscopic photography." F. Barrett. August 1st.

17,584. "Improvements in switches for electric balls." G. Harding. August 1st.

17,617. "Improvements in a coin controlled pay station for telephones." C. H. Carter. August 1st. (Complete.)

17,635. "Improvements in and relating to inductor generators." J. L. Milton. August 1st.

17,655. "Improvements in arc lamps." W. G. Heys. (The Scott Electrical Co., United States.) August 2nd. (Complete.)

17,658. "Improvements in prepayment electric meters." W. C. Bexon and J. D. Bexon. August 2nd.

17,659. "Improved adaptor for incandescent electric lamps." A. T. Thompson and G. H. Davis. August 2nd.

17,661. "Electric switch for series lighting." H. J. Dowsing. August 2nd.

17,686. "Improvements in space telegraphy." J. S. Stone. August 2nd. (Date applied for under Patents Act, 1901, August 3rd, 1906, being date of application in U.S.) (Complete.)

17,690. "Improvements in space telegraphy." J. S. Stone. August 2nd. (Date applied for under Patents Act, 1901, August 3rd, 1906, being date of application in United States.) (Complete.)

17,695. "Improvements in space telegraphy." J. S. Stone. August 2nd. (Date applied for under Patents Act, 1901, August 3rd, 1906, being date of application in United States.) (Complete.)

17,698. "Improvements relating to commutators and brush carriers of electric machines." L. Krieger and Compagnie Parisienne Des Voitures Electriques (procédés Krieger). August 2nd. (Date applied for under Patents Act, 1901, January 29th, 1907, being date of application in France.) (Complete.)

17,704. "Improvements in loud-speaking telephone apparatus." D. Marzi. August 2nd. (Date applied for under Patents Act, 1901, April 25th, 1907, being date of application in Italy.) (Complete.)

17,707. "Improvements in electric switches." C. E. Hunter and W. H. Warren. August 2nd. (Complete.)

17,717. "Improvements in electroplating." S. O. Cowper-Coles. August 2nd. (Complete.)

17,718. "General arrangement of a lifting magnet for electric arc lamps which have their juxtaposed electrodes brought into contact by the action of a weight." Deutsche Bec-Bogenlampen G.m.b.H. (Date applied for under Patents Act, 1901, August 2nd, 1906, being date of application in Germany.) August 2nd. (Complete.)

17,719. "Improvements in and relating to the distribution of electromotive power." H. C. F. M. Lange and G. W. Mascord. August 2nd. (Complete.)

17,722. "Improvements in and relating to electric controllers." British Thomson-Houston Co., Ltd. (General Electric Co., United States.) August 2nd. (Complete.)

17,743. "Improvements in or relating to the metallisation of vitreous, porcelain, earthenware and the like surfaces so that metal or metallic alloy may be electrolytically deposited upon such surfaces." Q. Marino. August 3rd. (Complete.)

17,768. "Improvements relating to filaments for electric incandescent lamps." R. de Fazi, F. G. Claussen and G. T. B. Cobbett. August 3rd.

17,781. "Improvements in electric arc lamps." A. D. Jones. August 3rd.

17,783. "Electro-magnetic reversing coupling." F. M. Meyer. August 3rd. (Complete.)

17,796. "Improvements in or relating to electric sign or display apparatus suitable for advertising and like purposes." G. C. Fricker. August 3rd. (Complete.)

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1906.

Covers of Electric Cells. A. E. Segnitz and W. E. Parkes. 15,200. July 4th.

Supporting the Plates of Secondary Batteries. A. E. Segnitz and W. E. Parkes. 15,200a. July 4th. (Date applied for under Rule 5, Patents Rules 1905, July 4th, 1906.)

Electric Arc Lamps. C. Oliver. 15,310. July 5th.

Electric Arc Lamps. C. Oliver. 15,310a. July 5th. (Date applied for under Rule 5, Patents Rules 1905, July 5th, 1906.)

Appliance for the Amplification of Signals Produced by Variation of the Load Currents in Wireless Telegraph Receivers. A. W. Sharman and De Forest Wireless Telegraph Syndicate. 15,615. July 10th.

Windings for Alternating-Current Dynamo-Electric Machines. L. J. Hunt and Sandycroft Foundry Co. 15,711. July 11th.

Hand-Operated Ignition Devices for Starting Explosion Engines. C. R. Greuter. 15,969. July 14th.

Receiving Apparatus for Use in Wireless Telegraph Systems. A. G. Hellyar and Johnson Secret Wireless Telegraph and Telephone Testing Syndicate. 16,747. July 24th.

Dynamo-Electric Machines. H. D. Farrell. 17,355. August 2nd.

Automobile and Like Electric Horns. W. D. Judkins. (Hutchison.) 18,070. August 11th.

Starting Switches for Electric Motors. A. D. Smith. 18,516. August 18th.

Dynamo-Electric Machines with Compensating Windings. L. Torda. 18,621. August 20th.

Systems of Electric Motor Control. British Thomson-Houston Co. (General Electric Co.) 18,877. August 23rd.

Construction of Switch for Automatic Electric Lifts or Elevators. J. Richmond & Co., Burnett and Lyon. 18,905. August 23rd.

Oil Break Electric Switches. A. Eckstein, A. C. Heap and D. Mellis. 19,005. August 25th.

Electrical Terminal Fittings for Effecting Junctions Between Sections of Main Cables and Main and Branch Cables in Conduit Junction Boxes, Without the Aid of a Soldered Joint. A. Hirst and C. E. Gunner. 19,690. September 4th.

Telegraphic or Secret Codes. B. McNeill. 20,131. September 10th.

Electric Switches. Electric Ignition Co. and F. H. Hall. 20,201. September 11th.

Removing Metallic Cylinders from Mandrels on which they are Electro-Deposited. S. O. Cowper-Coles. 20,639. September 17th.

Terminals and the like for Electric Conductors Especially Applicable for Use in Electric Incandescent Lamps. British Thomson-Houston Co. (General Electric Co., U.S.) 21,668. October 1st.

Multiple-Way Electrical Switches. A. P. Lundberg, G. C. Lundberg and P. A. Lundberg. 25,143. November 8th.

Magneto-Electric Machines more Especially Intended for Effecting Sparking for the Ignition of the Explosive Mixture of Internal Combustion Engines. A. De Saint-Romain. 25,877. (Date applied for under International Convention, May 25th, 1906.) November 15th.

Electric Furnaces. A. Reynolds. 26,981. November 27th.

Locking Frames for Operating Electrically-Controlled Railway Points and Signals. Siemens Bros. & Co. and L. M. G. Ferreira. 26,985. November 27th.

Wireless Telephony. L. de Forest. 28,125. December 10th. (Date applied for under International Convention, December 22nd, 1905.)

Submergible Electric Heaters. C. H. Stapledon. 28,549. December 14th.

1907.

Cooling or Ventilating of Alternating Electric Current Transformers. A. F. Berry. 5,554. March 8th.

Locking Device for Magneto-Electric Machines for Ignition Purposes. G. A. Unterberg and F. Helmle. 7,033. March 23rd.

Clip for Fixing Electric Conductors to Insulators. S. R. Von Sonnenthal. 522. January 8th.

Electrical Influence Machines Commonly Called Static Machines. A. E. Dean. 1,162. January 16th.

Indication of the Blowing of Fuses in Electrical Distribution Systems. F. Schultz. 3,523. February 12th. (Date applied for under International Convention, February 14th, 1906.)

Arrangement for Supporting Electric Motors on Shafts. J. Siegfried. 4,607. February 26th. (Date applied for under International Convention, March 3rd, 1906.)

Means for Automatically Breaking an Electric Circuit in the Event of a Leakage in Earth or Giving an Indication of Said Leakage. Nalder Bros. & Thompson, Ltd., A. F. Harris, J. Wallis-Jones and O. Cox. 5,885. March 11th.

Systems of Electric Traction. Allgemeine Elektricitäts Ges. 10,452. May 4th. (Date applied for under International Convention, May 4th, 1906.)